Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 144 SATURDAY, AUGUST 12, 1939 No. 3641

CONSERVATION OF ANTIQUITIES IN BRITISH DEPENDENCIES

THE Trustees of the British Museum (Bloomsbury) are to be congratulated on the acquisition of the remarkably fine bronze head from Southern Nigeria, to which reference was made in NATURE of July 15, p. 106. Not only is this an outstanding example of the highly developed artistic products of early West African culture, but also it belongs to a class of objects to which additions available for study in European collections are likely to be restricted in number in future. Since the beginning of the century, and arising possibly in a great measure from the publication of the bronzes and other artistic objects from Benin in the Pitt-Rivers collections, interest in and appreciation of the merits of the various schools of sculptural art native to African culture has increased rapidly and become widespread. In consequence, a number of characteristic examples, and many of exceptional merit, have been brought to Europe by collectors. During the past twenty years it has been known that bronze heads of remarkable character have been found from time to time in the course of excavation at Ifé in the Yoruba country of Southern Nigeria; but the discovery there in 1938 of a number of such examples of the artistic skill of an ancient and forgotten people, of which this British Museum acquisition is one, has quickened interest in these and similar objects of "high antiquity, artistic merit, and uncertain cultural origin", and as a result has induced those in authority to take steps to secure that West Africa should not be denuded of such interesting and important relics of its past.

In January 1939 the Government of Nigeria made an Order in Council enabling the Governor of Nigeria to control the export of antique African sculptural works of art; and since then the native authority of Ifé has taken action to protect the antiquities in the area under its administration. Such interest on the part of a native administration suggests that the subsequent action of the Secretary of State for the Colonies, announced in "The Colonial Empire" (the statement recently issued with the estimates for 1939) by which he has instituted inquiries with a view to the enactment of legislation throughout West Africa to secure the protection of indigenous African objects of ethnological import or æsthetic interest, will receive strong backing from a quarter which might not have been anticipated. It should ensure that any legislation which may be framed as a result of the inquiry will not become a dead-letter.

It is interesting to note that the Colonial Office, which frequently in the past has been accused of inertia when matters of moment to the scientific pursuit of cultural studies have been at stake, is now ready to give due heed to their interest and importance when attention has been directed to them. In Mr. MacDonald's own words: "Wherever such discoveries have been made His Majesty's Government has a keen interest in revealing them, and in preserving them, both on account of their scientific and historical value to scholarship, and on account of the susceptibilities of the local people, who naturally tend to regard these evidences of their cultural origins with reverence and pride".

It is in accordance with this policy that the

study of antiquities is fostered and their conservation has been taken actively in hand by the authorities in several of the dependencies under legislative enactment. In Palestine, for example, which for the student of early racial and cultural history, apart from its bearing on the origins of the Christian religion, now holds a foremost place among the regions of major interest and significance for scientific research, not only does the Government direct the course of investigation by the exercise of its authority, acting under skilled advice, but also through the Department of Antiquities is itself engaged in investigation. In addition to the archæological work which has been carried out under licence, the study of the past history of Palestine has benefited by the activities of the Department of Antiquities in the field.

The importance of Palestine in the historic development of modern civilization naturally tends to attract to it investigators from outside, drawn from all parts of the world; and Jerusalem, equipped as it is with University, Antiquities Department, and the headquarters of several national schools of archæological research, since the War, and since the termination of the British mandate in Iraq, has become by far the most important centre of archæological interest under British jurisdiction. It is, however, by no means the only one; and if it were only possible to ensure more adequate financial provision, both Malta and Cyprus in their respective fields of archæological and historical interest might make a fair bid to become not unworthy rivals of the Holy Land. In Malta in particular, remarkable prehistoric remains and culture present a number of problems to the archæologist, which still await solution. Here a notable step in advance has been taken by the foundation of a professorship in archæology at the Royal University of Malta, which it is hoped, in the words of Mr. MacDonald's report, "will prove a starting point for a more exhaustive development of Malta's archæological wealth". A survey of the monuments of the island is projected. This is a measure which has been too long delayed; and although the visitor to the island, who views the remarkable prehistoric structures which form one of its attractions and examines the archæological collections in the Museum, will appreciate the devoted service to archæological studies in Malta over many years of the late Sir Th. Zammit, the net result for the discerning is an uneasy feeling that too little support has been given to the investigation of a culture that in its way is unique. It is indeed to be hoped that a better day is dawning. Mr. MacDonald announces that the curator of the archæological section of the Museum has been on study leave in Europe, and after working on sites in England is proceeding to Rome and Athens.

Cyprus, an island rich in historic associations, as it is in antiquities, has in the past been much hampered by financial considerations; and these, notwithstanding assistance from private sources interested in the past history of the island, have not been entirely overcome. The work of the preservation of the ancient monuments of Cyprus nevertheless continues. In addition to the amount spent from the funds of the Government of Cyprus, generous assistance has been given towards this work by Lord Mersey's Cyprus Committee and by the Carnegie Corporation. Among the more important of the monuments to which attention has been given are the Castle of St. Hilarion, Bellapais Abbey, and the fortifications of Famagusta. In this work the Cyprus authorities have had the co-operation of the Office of Works, an official having been seconded from England to the Cyprus Department of Antiquities as superintendent of works, who has trained a Cypriote official to undertake this function after his own return to England.

In the conservation of antiquities, however, anything approaching safety is to be won only at the price of constant vigilance. In this connexion, it is interesting to find that in *Antiquity* of June, the editor, in directing the attention of his readers to a communication from Mr. Stewart Perowne, dealing with two ancient city sites of remarkable archæological interest examined by him in the Aden Protectorate, urges strongly the need for the appointment, without delay, of a Director of Antiquities for the Protectorate. He supports his argument by reference to the importance for archæological studies of this area, as indicated not only in the results recorded by Mr. Perowne, as well as those obtained by Miss G. Caton Thompson, Miss E. Gardner, Miss Freya Stark and others, but also by pointing out the imminent dangers of spoliation, if future exploration is not properly supervised, and adequate measures are not taken to protect the monuments and house the smaller finds of archæological research. There can be no question that the editor of *Antiquity* is right in thinking that archæological opinion in Great Britain is with him in this matter.

THE CASE FOR LEY FARMING

The Plough-Up Policy and Ley Farming
By Prof. Sir George Stapledon. Pp. 170. (London: Faber and Faber, Ltd., 1939.) 2*s.* 6*d.* net.

THE alternate husbandry system of farming has been widely practised in the parts of Britain with high and well-distributed rainfall for many years, but its spread to the more southerly parts of the country has been very slow. Until wild white clover seed and basic slag became available in sufficient quantity and at reasonable prices ley farming was not, in fact, suitable for the drier districts, because of the slow establishment of the leys; it must be remembered that it is only during the last twenty years that these commodities have become readily available. There have been many advocates in recent years for the wider spread of alternate husbandry; but the leader in this campaign has undoubtedly been Sir George Stapledon. Now that the movement has suddenly received the great stimulus of the Government subsidy for ploughing up pasture and derelict land, it is only fitting that he should issue a statement of the case for ley farming and a description of the methods necessary for success. This book covers the ground admirably, for not only are the wider aspects discussed but also details of manuring and cultivating, seed mixtures and seed production, even rabbits and moles and all the new problems which present themselves to the farmer adopting alternate husbandry.

Great emphasis is placed throughout the book on the building up of fertility. This indeed may be said to be the central thesis, and it makes the work especially valuable as a corrective to ideas very generally prevalent. The Government subsidy is clearly an emergency measure, designed to render a greater area fit to carry arable crops if the need should arise; the object is to persuade the farmer to take the first step towards cashing the fertility which may be stored up in land which has not carried arable crops for seven years or more. If the land has been under good grass, including a due amount of clover, and has been sufficiently grazed over a long period it will certainly be in a fertile condition; but much of the area that will be broken up is in a semi-derelict state and is in no form to produce good arable crops. It may be that Sir George Stapledon has devoted less of his book to the former class than its area merits, but most writers and speakers do the reverse, so that this work will do much to restore balance to the general view of the problem. Sir George Stapledon is an unrivalled authority on the farming of the poorest types of land, and he looks further ahead than the immediate future; he does not think so much of producing human food from accumulated reserves (which may not exist) as of the steady improvement of the land. Thus he does not urge the immediate growing of corn on poor land, but the sowing of short leys, including crucifers as well as grasses and clovers; he insists particularly on the value of Italian rye grass for grazing in the early stages of improvement.

It might be thought that the plough-up policy will find its greatest scope in the grassland districts, but there the equipment and knowledge for arable cultivation are sadly lacking: in the drier, eastern half of the country facilities already exist and a wide extension of ley farming may be expected. Most of Sir George Stapledon's work has been done in the west and some modification of methods may be desirable in the east. Aberystwyth has achieved great fame by its breeding of new strains of grasses and clovers; but the suitability of all these strains for drier conditions has not yet been adequately tested. The seeds mixtures recommended in this book, however, do not consist solely of the new Aberystwyth strains, the general advice being to blend them with the cheaper commercial strains. Where there is adequate rainfall the sowing of long leys on bare ground, rather than under a cover crop, is sound practice, convincingly demonstrated by wonderful examples of new leys at Cahn Hill and elsewhere; a luxuriant growth of leafy herbage is obtained in the first summer and it cannot be said that a year has been lost. But in a droughty summer, such as is common in the east of the country, there is very poor growth during the first summer, and lack of ground-cover invites the ingress of weeds. Uncertain rainfall makes it difficult to plan grazing far ahead and in drier districts there seems little future for special purpose leys, as recommended in this book; that greater efficiency can be got from them cannot be denied, but extreme variation in growth from year to year will probably make most farmers aim for a good all-round pasture, suitable for hay or for grazing at various times of the year as the exigencies of the moment may require.

It seems incredible that a book containing so much valuable material and one so stimulating can have been written and published in the short time since the Government subsidy for ploughing-up was announced; despite the rush in which the

work must have been done there are very few ambiguities or misprints and the style is Sir George Stapledon's usual clear and bracing one. In his preface he promises his readers a "proper book" on ley farming, written at his leisure; that will be eagerly awaited, but meanwhile the present book will prove extremely valuable. It is very easy to read, definitely practical throughout, and has appeared at a most opportune moment.

THE LEADER TO PERFECT HEALTH

The Englishman's Food

A History of Five Centuries of English Diet. By Prof. J. C. Drummond and Anne Wilbraham. Pp. 574+16 plates. (London: Jonathan Cape, Ltd., 1939.) 12*s*. 6*d*. net.

DIET is neither frivolous knowledge nor a curious science; it is the leader to perfect health. So, in similar words, wrote Thomas Muffett in 1655; the sentiments are as true to-day as then, when at long last the subject of diet is beginning to be understood.

A picture of the changing character of the English diet during the past five centuries against a background of social and economic history would have been of absorbing interest if compiled by a mere historian. It gains greatly in definition and is much enhanced in its educative value when the author, or one of them, is among the most knowledgeable experts of the modern school of dietetics, so that the reader is assured of higher criticism of an unusual degree of scientific accuracy interspersed among the historical facts on almost every page.

All through history and in all lands the rich have eaten too much and the poor too little. In the light of modern knowledge what matters most is whether that food has been of the right kind to combat disease, and perhaps it is from this point of view that the book is most interesting. It is divided into five periods, covering Tudor England and the four subsequent centuries: for each of these there is information relating to the meals of the people, to their health, with special reference to scurvy and rickets and to other pertinent matters.

In Tudor times, according to foreign visitors, the Englishman of every class fed better than his counterpart on the Continent. The peasants suffered badly when harvests failed, but in good years they were well nourished.

In the seventeenth century, men who had made fortunes out of trading ventures, in particular the East India Company, invested in land, and farming became a national concern. Previously the profits of the wool trade had been so tempting that even arable land had been sacrificed to grazing, bringing about a local shortage of corn; but now throughout the century the acreage under corn steadily increased, bringing down the price to 27*s*. a quarter so that bread was cheap, though there were, of course, disturbing fluctuations in times of bad harvest.

Farmers began to grow turnips and learnt how to store them during the winter packed in dry soil or sand. About 1664 an effort was made to encourage the cultivation of potatoes, which had already become so popular in Ireland and were rapidly forming the staple food of the peasantry. Fellows of the Royal Society were asked to plant the tubers in order to have a cheap food available for the necessitous poor. The art of gardening developed rapidly in England, and fruit and vegetables became available in greater variety and quantity, as witnessed by Evelyn's Diary. Very little progress was made in meat production, and much of the stock was slaughtered on the approach of winter.

In the eighteenth century, the rapid growth of the towns brought new problems partly connected with transport over bad roads, and it was not until canals were constructed in the latter half of the century that the problem was eased. Foodstuffs were required on a scale larger than they could be brought to the towns and there was a marked deterioration in the quality, particularly in those likely to be bought by the poorer people. The trade in food began to be commercialized. The public demand for a white bread led to the addition of alum to flour and other grosser forms of adulteration. Meat came slowly to the towns, being sold from fair to fair and coming on foot even all the way from Anglesey to London. Before sale, cattle were kept in the vicinity of London and fattened for the city markets. Much of the meat was tainted: young people were warned by Dr. Truster to refrain from "smelling to the meat whilst on the fork". Fish and poultry also came on the market.

England was opulent during the first half of the century and a rise in the standard of living of the working people was favoured both by the cheapness

of food and the appearance of cheap fabrics, candles and other products of new industries within the reach of their purses. The picture changed soon after the accession of George III; there was a disastrous sequence of bad harvests from 1764 until 1775 and the wars with America and France tended to keep prices high.

In the nineteenth century, the conditions worsened so far as the poor man was concerned. In the towns, during the first half of the century, the greater part of the nourishment came from bread, potatoes and strong tea. The consumption of tea was ever increasing and was nearly 4 lb. per head in 1871. The drinking of large quantities of hot fluid tended to reduce the intake of other more nutritious foods—a glass of cold beer would have contained far more real food. There is a similar problem in Norway to-day, where large quantities of hot 'black' coffee are drunk, so reducing the consumption of milk.

In the rich man's house the same period witnessed the growth in popularity of the typical English breakfast which has lasted a century, though there are signs that it is to-day being abandoned.

The nineteenth century also saw a deterioration in physique—at least this is the grim heading of Chapter 22. The decline in breast-feeding of children, the prevalence of rickets, bad teeth, and above all the displacement of grinding corn between stones by roller mills, all had their effect. The intake of vitamin B dropped to one third of what it had been and there was widespread deficiency in other vitamins. In the authors' words, "the opening of the 20th Century saw malnutrition more rife in England than it had been since the great dearths of medieval and Tudor times".

The few reformers, chief among whom was Seebohm Rowntree, found it difficult to awake the public conscience, and it was not until it was discovered during recruiting for the South African War, and still more during the Great War, how very large a percentage of would-be recruits was below the standard, that alarm was aroused. Even then other conditions were blamed in preference to defective diet. The discovery of the vitamins and the realization of their importance in the dietary gave an entirely new aspect to the science and practice of food and nutrition.

One of the chief post-War changes has been a general increase in the standard of living and a change from cereals to meat, milk, fruit and vegetables. The consumption of fruit and vegetables has nearly doubled, that of bread has halved. Latterly, progress has gone apace though there is still all to do: that it has been effective is demonstrated by the figures, announced at the time of writing, relating to the youths of 20–21 called up for the militia. The number of those in the lower categories is barely 10 per cent and some 20,000 more have been passed than was anticipated.

Generally speaking, Britain is becoming food conscious though not to the extent that prevails across the Atlantic. She owes much to her American cousins for what they are teaching her in this respect—indeed they have saved her from the somewhat tardy action of the medical profession.

This brief survey indicates the theme which runs through the book—it is elaborated at every turn with all kinds of information, and it would be possible to abstract from it the story of rickets or milk or other subject.

The book is stimulating beyond words; any reader of it must surely become a disciple for the cause of better feeding of our people. It is partly no doubt a question of poverty, but by no means entirely so.

Whilst much can and must be done by feeding school children, there is even more to be achieved by education. Probably, as a whole, the English are still the worst cooks and the most improvident housekeepers in Europe—a French working-class family was formerly said to be able to live on what its opposite number in England wasted, and there is still much truth in the gibe. The public must be made to realize that their health depends on their food and the way it is cooked and that health should have first call on the scanty pennies, even before the cinema or the football pools, on which ten million people spent £50 million pounds last year.

The man of science has shown a sad lack of imagination in his nomenclature of the vitamins. The use of A, B, C, D, E, etc., conveys nothing to the man in the street, who cannot possibly be expected to memorize their functions. They might at least be given names which indicate that they are antiscorbutic or antiricketic or provirility or something else. Their appreciation by the public is being retarded by the inability to talk about them by appropriate names. Our literary friends must cease their smiles at our impotence and come to our assistance—a nation which finds names for its racehorses should not be defeated by a few vitamins.

Drummond and Wilbraham will be widely read; it would be good for the nation if its sale exceeded that of the most popular novel. It should stimulate the body scientific to more work. We ought to know a lot more about the inner make-up of our foodstuffs—such as the difference between flesh, fish and fowl, the distribution of inorganics, on the chemical side; or the result of various deficiency factors on the biological side.

E. F. ARMSTRONG.

MAGNETIC OBSERVATIONS OF SUNSPOTS

Magnetic Observations of Sunspots, 1917-1924 By George E. Hale and Seth B. Nicholson. Part 1. Pp. iii + 91 + 8 plates. Part 2. Pp. ii + 692. (Papers of the Mount Wilson Observatory, Vol. 5, Parts 1 and 2.) (Washington, D.C.: Carnegie Institution (Publication No. 498), 1938.) 10 dollars.

IN these two volumes the late Dr. G. E. Hale and his colleague Dr. S. B. Nicholson give a connected account of the instrumental developments, and the observations, that proved the existence of strong local magnetic fields at the sun's surface. This account occupies fifty-seven pages of volume I. The remaining thirty-four pages contain tables giving the daily classification of every sunspot group observed at Mount Wilson from January 1, 1917, to January 1, 1925, and the maximum magnetic field-strength observed in each group. The second volume reproduces the Mount Wilson daily sketches of the sun's surface, showing the sunspot groups with their various members, and indicating the polarity and the approximate magnetic field-strength of these members. An examination of these sketches cannot but impress the reader with the wealth of results on sunspot magnetic fields that Hale and his fellow-workers have accumulated; they form a rich mine for theorists in solar physics, whose task in this field is, as yet, scarcely begun.

The general account of the work begins with a brief description of the state of solar observation, and of opinion on sunspots, in the eighteen-eighties, and of the successive steps that led Hale to develop the spectroheliograph and the tower telescope as a means of gathering something of "the rich harvest" which "lay open to the spectroscopist who would apply high dispersion to a study, not merely of sunlight, but of the light of isolated features of the sun's surface, such as sunspots". The foundation of the Mount Wilson Observatory gave him his opportunity to build first the 60-ft., and then the 150-ft. tower telescope, associated with auxiliary apparatus of the finest quality. The discovery by Hale and Ellerman of hydrogen vortices over sunspots impelled Hale to suggest, in 1908, that such vortices might be associated with electric currents, which would produce magnetic fields; he described how, by studying the polarization of the light, the Zeeman effect on the spectral lines of light from sunspots might be investigated, and announced his intention to make such observations.

Supported by laboratory investigations on the Zeeman effect, Hale's observations of the Zeeman effect in sunspots were brilliantly successful: soon a regular daily routine of magnetic observations on sunspots was developed. The magnetic intensity and the direction of the magnetic lines of force, over different parts of spots and in the surrounding area, were determined. The first great discovery was that sunspot groups usually consist of two members, single or multiple, of opposite magnetic polarity; "only about 15% of all groups observed fail to show at least a tendency towards bipolar structure". At any one time (except near sunspot minimum) the polarity of all the leading spots of bipolar groups in the northern hemisphere of the sun is in general the same, and opposite to the polarity of the leading spots in the southern hemisphere.

In 1913, at the first sunspot minimum after the observations had begun, came a second great and much more astonishing discovery: the system of polarities of the spot-groups of the new cycle was opposite to that of the spot-groups previously observed: some error was suspected, but the scores of checks applied did not shake the validity of the evidence, and the reversal of polarity was afterwards observed again in 1923 and 1933. This showed that the "old" sunspot cycle of about eleven years is only half of the true 22-year "magnetic sunspot cycle".

The magnetic field-strength was found to vary roughly in proportion to the area of the sunspot, from a maximum of about 4,000 gausses to values of the order 100 gausses in the smallest spots observable with present instruments. The field-strength decreases, on the average, from a maximum at the centre of the umbra of a spot to a very small value at points not far outside the outer boundary of the penumbra; at the spot-centre the lines of force are approximately radial, and thence they decline more and more until at the edge of the penumbra their inclination to the sun's surface is only 25° or less.

The authors conclude their general discussion with the following words: "Although many theoretical investigations of the internal state of stars like the sun have been made, including two important papers by Emden and Bjerknes that call for the existence of very different types of vortex phenomena, much time may elapse before a satisfactory rational explanation of the magnetic effects described in this volume can be found. Such an explanation must take into account the striking phenomena of the solar atmosphere shown

by the spectroscope, the spectroheliograph, and the spectrohelioscope, as well as the minute Zeeman effects that reveal the general magnetic field of the sun. Various geophysical phenomena, including magnetic storms, the aurora, and those associated with the transmission of radio messages, are also involved. Indeed, we may reasonably hope that some of the most fundamental questions of physics, chemistry, and astronomy may be illuminated by an intensive study, both observational and theoretical, of the problems of solar magnetism." S. CHAPMAN.

THE CHINESE PEASANT

Peasant Life in China

A Field Study of Country Life in the Yangtze Valley. By Dr. Hsiao-Tung Fei. Pp. xxvi + 300 + 14 plates. (London: George Routledge and Sons, Ltd., 1939.) 12*s*. 6*d*. net.

"I VENTURE to foretell," says Prof. Malinowski in opening his interesting preface to this book, "that 'Peasant Life in China' by Dr. Hsiao-Tung Fei will be counted as a landmark in the development of anthropological field-work and theory." Later he quotes Sir Denison Ross in a statement in which he defines the position of this work in scientific literature and says "I regard this treatise as quite exceptional. I know of no other work which describes at first hand and with intimate understanding the full story of life in a Chinese village community. We have had works dealing with statistics, economic studies and novels full of local colour—but in no book have I found the answer to every enquiry, which the curious stranger might make". Commendation could not well go further. These authorities, each selecting for mention a quality and aspect of this piece of field-work, which offers to him a special appeal, emphasizes its two-fold interest for the reader. On one side the book is a first-rate study of social conditions, which though drawn from a limited area, may be taken as applying with local modifications to a preponderance of the population of China immediately before present Japanese aggression; on the other side it is a practical demonstration of the contribution to be made by anthropological studies in the field towards a planned approach to the solution of the problems, political, social and administrative, which arise from cultural contacts, when Western civilization impinges on other, and in a material sense, less advanced forms of civilization.

Dr. Fei has taken as the scene of his operations Kaisienkung, a village south of Lake Tai in the Yangtze plain in eastern China. The country is a network of canals and waterways, communications being mainly by boat. The density of population reaches the remarkable figure of 1,980 per square mile, this calculation, however, being based on land surface only, whereas the gross density of the whole province (Kiangau) is about 896 per square mile. The main industry is agriculture (rice cultivation) in a system in which the unit of social and economic organization is the expanded family. The returns from rice cultivation, over and above family subsistence requirements, were not adequate to meet family expenditure. They were supplemented by the production of silk as a domestic industry. The village, in fact, was in the centre of the silk-producing area of China. Unfortunately, the fall in world prices of silk has brought disaster to the industry, and the district, like many others, is face to face with the great agrarian problem of China, namely that the cultivation of the land, unsupplemented by other resources, will not support the peasant population.

Dr. Fei reviews in detail, "microscopically" as he puts it, the traditional social and economic system of this village as a working organism, and indicates the changes which have been forced upon it by disintegrating factors, both external—world economic and social conditions—and internal, due to efforts to ameliorate conditions within the village itself. Of these the most important is the endeavour to raise the standard of silk production and the institution of a village silk factory. Of the changes in custom due to the economic situation, the most striking is the curtailment, or complete cessation of all ceremonial and festive occasions over a period now of ten years duration. One result, for example, is not only the postponement of marriage to a later age, but also a modification of the character of the marriage system itself on the ground of the expense involved in the customary marriage ritual. The introduction of a co-operative factory and wages, which were previously unknown, have had a number of social repercussions, but not the least serious, both in the silk industry and in agriculture, where labour-saving methods of cultivation have been introduced, has been the creation of a class of unemployed labour, especially among the female population.

The village described by Dr. Fei has now been overwhelmed by the Japanese advance; but the author is nevertheless confident that China, as ever before, will eventually rise superior to her trials.

THE REALM OF BIOCHEMISTRY

(1) Outlines of Biochemistry: the Organic Chemistry and the Physicochemical Reactions of Biologically Important Compounds and Systems
By Prof. Ross Aiken Gortner. Second edition. Pp. xx+1017. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 30*s*. net.

(2) Organic and Bio-chemistry
By Prof. R. H. A. Plimmer. Sixth edition. Pp. x+623. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 21*s*. net.

(3) Biochemistry for Medical Students
By Dr. William Veale Thorpe. Pp. viii+457. (London: J. and A. Churchill, Ltd., 1938.) 12*s*. 6*d*.

IT is welcome to have under review at the same time three such excellent books on biochemistry dealing with different stages through which students in this science will be expected to pass.

The first two have passed the first edition, and Gortner's book is the second edition of the well-known text-book which has been brought up to date and amplified in accordance with modern needs.

The second book, by Plimmer, is the sixth edition of this well-known treatise and has also been amplified and brought up to date.

The third book is a student's text-book which has been written by a newcomer in this field, and deals with such matters as may be required by the medical student.

Time was not so very long ago when biochemistry was treated as a section of physiology, and so far as science was concerned remained in relation to organic chemistry a mass of empirical data which seemed to bear little or no relation one to the other.

The books under review indicate that the physiological side of biochemistry is rapidly diminishing in importance and the subject is being based more and more strongly on organic chemistry with its strictness of formulæ and diction. In fact, there seems to be no hope of ever reaching any knowledge of what underlies the chemistry of life unless biochemistry is approached from the pure science of organic chemistry. It is pleasant to note that in the three books under review the basis of organic chemistry is held in mind continuously and wherever possible the line followed is that of established reason rather than of empiricism. Plimmer's book, and that by Gortner, are text-books of the science which deal in detail with the whole subject; that by W. V. Thorpe contains a wealth of interesting detail. It restricts itself to that which the medical student requires, and the student who has acquired the knowledge contained in this book will not have laboured in vain.

J. F. T.

THE MANIPULATION OF GASES

Experimental Methods in Gas Reactions
By Dr. A. Farkas and Dr. H. W. Melville. Pp. xv+390. (London: Macmillan and Co., Ltd., 1939.) 30*s*. net.

THIS treatise will become a standard work and a necessary reference book for all physicists and chemists engaged in conducting experimental researches with gases. Its usefulness is enhanced by the fact that the authors have had actual practical experience with many of the devices and apparatus described, and are therefore well qualified to point out the limitations, defects and advantages of alternative methods of procedure. The arduous labour of collecting from scattered sources information hitherto imperfectly catalogued has resulted in a valuable contribution to science in a very practical form. The references are very numerous, the diagrams clear, and the printing, especially of the formulæ, admirable. The mathematical relations quoted in the text have in many cases been deduced from first principles, and theoretical questions of sufficient fundamental importance have not been left unexplained.

In the preface the authors state: "The book is designed mainly to give a reasonably complete account of the methods of investigating all types of gaseous reactions together with sufficient theory, in order that there should be the minimum gap between theory and practice. While it is intended that the beginner will benefit from the work, the text is arranged in such a way that it may serve as a book of reference for those chemists and physicists engaged in dealing with gas reactions, with high vacua, or with any investiga-

tions where a knowledge of the preparation and handling of gases is required". They also explain that there is no chapter on macro-gas analysis, the reason being that there are several excellent books on that subject.

The first chapter is devoted to an account of the elements of the kinetic theory of gases from the modern point of view. This happy combination of theory with practice—a characteristic of the work throughout—has very much enhanced the attractiveness of the reading. The second chapter gives an exhaustive account of apparatus for the control of pressure and temperature. It includes a description of the various types of vacuum pumps and pressure gauges, and has a section on taps, valves and lubricants. There is, however, no mention of the recent work in America and in Great Britain on phosphoric acid lubricants. This is the only omission of importance which we have found.

The third chapter deals with the preparation and analysis of gases, and includes directions for preparing the two forms of hydrogen and deuterium. The section on micro-gas analysis includes analysis by low-temperature distillation, and the estimation of *ortho-* and *para*-hydrogen, deuterium, etc. The fourth chapter, on photochemical technique, deals with absorption spectra, sources of radiation, methods of controlling radiation, light filters, and the measurement of radiation intensity.

The fifth and last chapter deals with the wide subject of experimental methods for the investigation of gas reactions. It includes explosive reactions, and optical methods of investigation, and the great variety of catalysts are described. The section on catalysts is particularly valuable in its examination of the different forms in which metallic catalysts may be used, and in its warnings on the dangers of poisoning and sintering.

Throughout the book useful guidance concerning manipulation and the construction of apparatus has been given. The authors are to be congratulated on a comprehensive and able piece of work.

D. L. C.

REGNUM ANIMALE

Caroli Linnaei Systema Naturae
A photographic Facsimile of the First Volume of the Tenth edition (1758). Regnum Animale. Pp. viii+824. (London: British Museum (Natural History), 1939.) 10*s.* 6*d.*

THE first volume of the tenth edition of Linnæus's "Systema Naturae", published in 1758, is now universally accepted by zoologists as the starting point for the application of the rule of priority in the scientific naming of animals. This particular edition was selected for the purpose because it was the first in which Linnæus consistently applied a binomial nomenclature to the species, while, on the other hand, it was the last to be published during his lifetime. It is probably safe to assume, however, that only a small minority of zoologists have ever had an opportunity of handling a copy of this somewhat rare book. Even the reprint of it published by the German Zoological Society in 1894 has long been out of print and seldom appears in catalogues of secondhand books. The Trustees of the British Museum have, therefore, rendered a service for which zoologists ought to be grateful in publishing a photographic facsimile of one of the copies in their library. The particular copy which has been used for the reproduction can be identified because care has been taken not to expunge the marginal notes and library stamps which it carries, a precaution that may prove one day to be important in the case of a work where much may turn on the spelling of a word or the position of a comma.

Even those who find the endless legal arguments as to the 'correct' names of animals little to their taste may discover much that is of interest in this old book. Linnæus, although he was much less of a zoologist than a botanist, had a broader conception of systematic zoology than we have to-day. His "Systema Naturae" was meant to be something more than a mere enumeration of species and their diagnostic characters; it was to be a summary of all that was known about them. Appended to many of the species are notes, condensed as only the Latin language can condense them, on the bionomics, ecology, distribution, and uses of the animals dealt with. For example, under "*Felis catus*" there is a delightful little paragraph giving (one imagines) a portrait of a privileged member of the family sitting by the stove in the old Linnæus house in the Botanic Garden at Uppsala, "tranquilla, ore molat, caudam erigit; excitata agillissima scandit, irata fremit . . . Murum Leo, in praedam intenta caudam movet . . . os instante tempestate manu lavat, dorsum in tenebris electrisat; in altum acta decedit in pedes" and then, when Linnæus has been kept awake at night, he writes "clamando rixandoque misere amat". But "odore ambrosiaco" must be ironical.

W. T. CALMAN.

THE ROYAL SWEDISH ACADEMY OF SCIENCE

BICENTENARY CELEBRATIONS

BY DR. J. RAMSBOTTOM, O.B.E., PRESIDENT OF THE LINNEAN SOCIETY

THE inaugural meeting of the Royal Swedish Academy of Science (Kungl. Svenska Vetenskapsakademien) took place on June 2, 1739, and the celebration of its bicentenary is to be held in Stockholm during September 23–25.

The Academy was founded mainly on the suggestion of Captain Mårten Triewald, who enlisted as supporters for a scientific academy publishing in Swedish, Jonas Alström, Baron Sten Carl Bjelke, Carl Wilhelm Cederhielm, Baron Anders Johan von Höpken and Carl Linnæus. A meeting was called at the Riddarhuset (House of Nobles) to form an "Economic Scientific Academy for the promotion of useful sciences"; the name

TWO OF THE STAMPS ISSUED BY THE SWEDISH POST OFFICE TO MARK THE BICENTENARY CELEBRATIONS OF THE ROYAL SWEDISH ACADEMY.

"Swedish Academy of Science" was adopted, however, on the advice of Anders Celsius. The first president, chosen by lot, was Linnæus, then thirty-two years of age; the first secretary was von Höpken, an influential young nobleman who later filled in turn the highest offices of State. Von Höpken was responsible for drawing up the proposed statutes adopted at the inaugural meeting, and confirmed later by the King, who permitted "Royal" to be added to the title of the Academy. Linnæus was president only for the first four months and each of the original members succeeded him, sooner or later, in office. Under his presidency, thirty new members were elected, many of them men whose support he valued.

Subscriptions at first were in cash and in kind, Linnæus's presentation of a copy of his "Hortus Cliffortianus" and two Chinese books, on rice and silkworms, starting the present rich library. The printing of the *Transactions* was planned, with a device for the title-page of an old man planting a palm tree, and the inscription "För Efterkommande"; an original sketch for this is in the possession of the Linnean Society of London. On relinquishing office, Linnæus delivered a formal oration, "On Curiosities in Insects", setting an example followed by all succeeding presidents.

In 1747, the Academy was granted the privilege of publishing the Almanack and State Calendar, a privilege several times renewed, and which is still its chief source of income.

The Academy was immediately successful, and by 1746 its membership had reached one hundred, a number to which the Swedish membership was later formally limited and it was only this year that it was agreed that in certain circumstances the number may be increased to one hundred and thirty. The prestige of the Academy led to the election of many of the most prominent men in the country, but though it was realized that much was to be gained socially and financially by this it was insisted upon that there should be real and active participation by all those elected. The earliest statutes expressly ruled that if any member "contrary to expectation" had not for two years sent in any work or done anything to promote the welfare of the Academy, such a member "being superfluous" should, after two years, lose his seat and his vote in the deliberations. Obviously such a rule was tricky to apply, and motions to effect it were occasionally shelved. However, five members were expelled in 1748, and 1783 saw the last of such expulsions.

Early in its history, the Academy undertook the building of an astronomical observatory for which the city of Stockholm contributed the site and the State made a grant; the establishment was removed to a new observatory at Saltsjöbaden, ten miles south-east of Stockholm, in 1931. Pehr Wilhelm Wargentin, the famous astronomer and statistician, became director of the Observatory on its completion in 1753; he had served as secretary of the Academy since 1749, and with an enormous capacity for work he was able to continue in office until his death in 1783, having an assistant, provided from a private source, only in the last seven years.

After Wargentin's death, the Academy suffered a period of decline doubtless connected with the difficulty of finding an efficient and energetic successor. Various expedients were tried in order to lighten the labours of the principal secretary,

but it was not until the celebrated chemist Jöns Jakob Berzelius took on the post in 1818 that satisfactory progress was resumed.

Elections were made in the eighteenth century without regard to a properly balanced representation of the different branches of learning. Different proposals were put forward to alter this, and in 1798 it was agreed to divide the members into seven groups. The stated object of the Academy was the promotion of useful sciences, and the first two groups, National Economy and Agriculture and Trade and Commerce accounted for a quarter of the members. Berzelius with his organizing ability and broad views soon brought about changes. In 1821 he had the two 'practical' groups combined and the Natural Science and Medicine groups increased from four to seven with the object of making the Academy purely scientific. This classification lasted until 1904, when a revision was necessary owing to the task of awarding two of the Nobel prizes—the aim being to give more prominence to chemistry and physics. He also had the rules for electing members revised. Each group had to submit "a well-thought-out and well-founded proposal" which was placed before a full meeting of the Academy. Berzelius was insistent that it was the duty of members to keep in touch with the progress of research, and the annual festival of the Academy (March 31) was chosen for the delivery of reports on the different branches of science. The reports during Berzelius's long tenure of office were augmented and published, he himself being responsible for chemistry, and for physics also until 1839. The series was translated into French and German and was of the greatest importance; but the task of preparation grew heavier, and shortly after Berzelius's death in 1848 it was found impossible to continue them. Not only did Berzelius lay the foundation of the present constitution of the Academy, but also by obtaining a fixed annual grant for the library and greatly extending its exchanges insured its present eminence.

Like all such national societies, the Academy became possessed of large museum collections, which gradually became too extensive for the curatorial facilities it could afford. When therefore Gustav von Paykull presented his large zoological collections to the Crown in 1819, and the King entrusted their care to the Academy, the Academy presented its own zoological collections to the State. Thus began the Naturhistoriska Riksmuseum which, though a national museum, is under the supervision of the Academy. In 1841 the botanical, mineralogical and ethnographical collections were also transferred to the Museum. Recently the last-named have been separated off as an independent institution—Statens etnografiska museum—which, however, is still supervised by the Academy.

A bequest by P. J. Bergius in 1790 of his estate of Bergielund just outside Stockholm for the purpose of establishing there a model botanical garden scarcely achieved its object because of lack of funds for ninety years or so. Then owing to the growth of Stockholm the area was included within the city boundaries with a consequent increase in value; the eighteen acres were sold and a site of more than sixty acres purchased about a mile north of the city and the present Bergian Garden established together with a School of Gardening. The president of the Academy for 1939–40, Prof. Robert E. Fries, is director of the Botanic Garden.

Among other institutions administered by the Academy are the Nobel Institute for Physical Chemistry set up in 1905 with S. A. Arrhenius as director until his death in 1927; this was replaced in 1933 by the Nobel Institute for Theoretical Physics with C. W. Oseen as director: the Kristineberg Marine Zoological Station, the Mittag-Leffler Foundation for Mathematics, the Physical Institute, the Abisko Natural Science Station and the Committee for the Protection of Nature.

The Academy usually meets twice monthly, except in summer, at Novra Djurgården, a district which is commonly known as Vetenskapsstaden (Science City) and which may be compared in some ways with South Kensington. The annual festival is traditionally held in the Riddarhuset, and is usually attended by members of the Royal Family.

To mark the celebrations, the Swedish Post Office has issued four special stamps, two with a portrait of Linnæus and two with that of Berzelius—one of each is illustrated here. The portrait of Linnæus is apparently taken from the Academy's painting by Roslin and that of Berzelius from the one by Södermark.

The preliminary programme announces that the delegates and guests will meet on Saturday afternoon, September 23, at the Academy building and afterwards visit the institutions at Vetenskapsstaden. In the evening there will be an informal dinner. On Sunday afternoon, the bicentenary festival will be held in the Stockholm Concert Hall in the presence of H.M. the King and other members of the Royal Family. In the evening there will be a banquet in the Stockholm Town Hall. On Monday the Stockholm Observatory at Saltsjöbaden will be visited, tea will be taken at the Royal Palace and in the evening there will be a gala performance at the Royal Opera House.

Delegates have been sent a pamphlet on the history of the Academy prepared by Dr. Arne Holmberg, the Academy's librarian. I have had free use of this in compiling the above account.

THE WYPERFELD (MALLEE) NATIONAL PARK, VICTORIA

By SIR JAMES BARRETT, C.B., C.M.G.

THE Wyperfeld National Park is situated about 300 miles north of Melbourne in the midst of the country known as the Mallee, which occupies about one fifth of the area of the State of Victoria. The soil of the Mallee varies greatly; but much of it, when cleared of the Mallee eucalypts, has proved excellent wheat country. The clearance was due to the invention of the stump jump plough and the roller. It varies greatly in quality, being in some places almost entirely sandy and in others fertile red soil. All of it is very liable to wind erosion, unless special precautions are taken to preserve both belts of eucalypts and some surface vegetation, and so far these precautions have not been taken in general.

At some geological period the whole of the area appears to have been a gulf of the sea into which such rivers as the Murray, the Murrumbidgee, the Goulburn and other Victorian rivers poured their waters, carrying with them silt from the Alps. This gulf has been filled up. The rivers have for the most part fallen to small proportion or are actually dying. I am informed that bores put down go through 200 feet of lake deposit before the marine deposits are reached.

The Wimmera River, once a large stream, running north from the Grampians, enters at Jeparit a large lake called Hindmarsh and then another—Lake Albacutya—and finally passes north for many miles through the Park itself and loses itself in sandy country. It has flowed in this way usually about once in fifteen to twenty years. I saw it in 1922–23 when the water for a year or two covered the lower 12 feet of the giant eucalypts on the river bed; it gradually evaporated and became saline and then dried altogether. At the present time the only available water is from one well provided with a windmill which, so far, has given a good supply.

The large eucalypts are found only in or near the river bed. The annual rainfall, which is capricious, is something less than 9 inches and the evaporation is enormous. There are quite a number of open spaces with good soil well grassed but flooded when the river resumes control. It is on these areas that the cattle, the emu and the kangaroo feed in the main but not exclusively. The sandhills are enormous, but I have not seen any evidence of any considerable movement.

The biological interest of this arid region of 82,000 acres is the fact that it is well stocked with animals which, since its reservation and with protection, have greatly increased. The black-faced kangaroo, found only in the Mallee, is abundant; emus are plentiful but constantly shift from place to place. It is probably in Victoria the last home of that wonderful bird—the mound builder, called the lowan, which incubates its eggs in the vegetative centre of mounds which it builds and which in one case I measured was 18 ft. in diameter and 4 ft. high (Fig. 2). The parents evidently watch the mounds but, after hatching, the young birds fend for themselves. With protection they have increased in numbers and in their fearlessness of man.

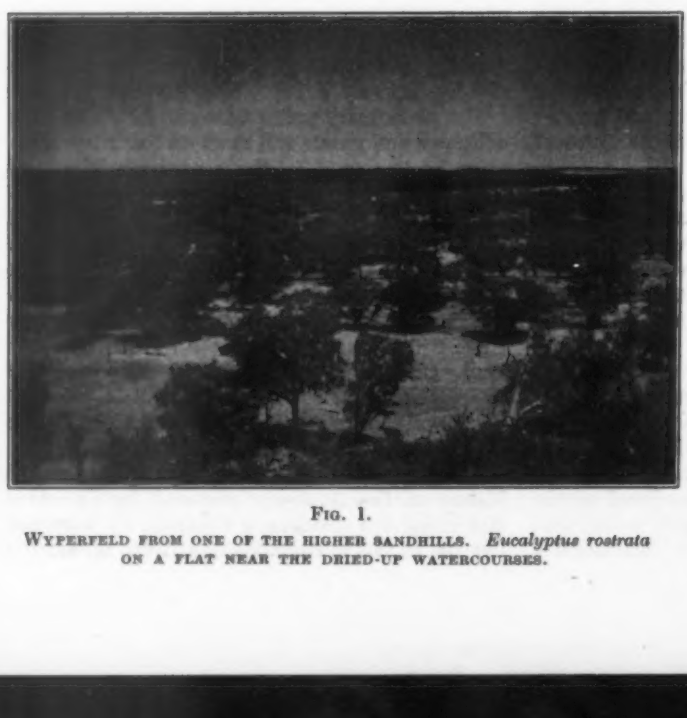


FIG. 1.

WYPERFELD FROM ONE OF THE HIGHER SANDHILLS. *Eucalyptus rostrata* ON A FLAT NEAR THE DRIED-UP WATERCOURSES.

But the major interest which led to the reservation was the fact that it is the home of vast numbers of the parrot and cockatoo family, which apparently nest in the large eucalypts and feed in the desert away from the river. The Regent parrot and the Major Mitchell cockatoo, the disappearance of which

was feared, have become abundant.

The birds drink at the trough provided at the well, but so far no one has seen the kangaroos at this source; yet a tame kangaroo I have in Melbourne drinks greedily. Precisely how they obtain sufficient water in the Park is, so far, unknown to us.

Of reptiles there are only the stumpy tailed lizards, a few tree-climbing lizards, but rarely a snake.

I may add that during the recent heat burst, the temperature to the north of the Park reached 119° F. Many magpies died, a few parrots were lost, but the kangaroos, though exhausted and collapsed, managed to survive.

Fig. 2.
Eucalyptus rostratus WOOD WITH *Acacia* IN BACKGROUND AND LOWAN'S NEST IN FOREGROUND.

The Park is leased to a cattle grazier at a low rental, but in return he acts as curator and is well informed of the habits of its inhabitants. A clause in the lease provides that if a fire occurs in the Park his lease may be cancelled. So far no fire has occurred, but during the recent disaster a fire outside the Park was just stopped on the boundary.

The profound interest of the Park lies in the fact that in the arid though very beautiful reserve the animals have adapted themselves to these dry conditions and show no desire to leave it. It should be added that no complete or adequate biological survey has yet been made. There are indications that some of the smaller marsupials may be found. Such a survey can only be made by residence in the Park and a careful search made, especially at night, with a powerful searchlight.

We are indebted to three Ministers of Land for the reservation, which was not easy to secure, namely, the late Mr. Owan, Mr. Bailey and the present Minister, Mr. Lind.

BOTANICAL CHARACTERISTICS

By Prof. J. S. Turner, University of Melbourne

The Park, so far as it has been investigated, seems to be composed of two distinct types of vegetation, each with its own soil environment. First, there is the vegetation along the outlet creek from Lake Hindmarsh. Along this creek is a chain of lakes, usually empty, of which Brambruk is one within the Park itself. Along these dried-up water courses there are two eucalyptus communities: (1) the red gum, *E. rostrata*, which is the more moisture-loving of the two; (2) the black box, *E. bicolor*. The forests formed of these trees are very open and the floor is grassed. Both communities are found elsewhere in Victoria.

The second main type of vegetation is of greater interest and constitutes what is locally known as 'desert'. It is made up of wind-blown sandhills of comparatively recent origin but not, at present, mobile. These sandhills are entirely distinct from the sand ridges found in the settled regions of the Mallee. In these more settled parts, the original vegetation was largely the Mallee eucalypts, but in the 'desert' these trees are much less frequent.

In spite of the inhospitable character of the sandhills and the very low rainfall, the 'desert' area carries a large number of typical Australian plants. The family Myrtaceæ is represented by Eucalyptus, Leprospermum and Melaleuca; Leguminosæ by Acacia; Proteaceæ by Hakea and Banksia; Epacridaceæ by Leucopogon and Astroloma; Casuarineæ by Casuarina; and Coniferæ by Callitris.

The sandhills are frequently capped by species of Callitris, *C. verrucosa* being probably the commonest. These pines are, however, dwarfed, and the sandhills cannot be compared to the pine ridges in other parts of the Mallee. Below the pines occur a large number of tall shrubs and small trees; for example, *Leptospermum coriaceum*, *Banksia ornata*, *Casuarina Muelleriana*, which last species has a restricted range but is abundant in the Park.

Acacia spinescens is a very spinous shrub. *Astroloma conostephioides* has conspicuous brilliant red flowers. The two genera Pimelea and Hibbertia, which are very widespread in Victoria, are both

represented here by very handsome species, *P. stricta* and *H. virgata*. These two species differ from most of those in the Park, in that their leaves are not sclerophyllous. The vegetation does not nearly form a complete cover on the sandhills, but it is sufficient to prevent wind erosion.

As in deserts in other parts of the world, this area bears a large number of minute annuals with a very short life-cycle. The number of these species in Wyperfeld will probably be found to be very large. The family Compositæ is particularly well represented. *Toranthus Muelleri*, *Brachycome pachyptera* and *Gnaphalodes uliginosum* are all extremely minute annuals found in the Park. Most of these species spend a dry season as seeds and pass through their short life-cycles soon after periods of heavy rain, and they are consequently easily missed by investigators of the flora.

Geological Characteristics

By Dr. E. S. Hills, University of Melbourne

The rocks of the Mallee are marine, estuarine, fluviatile and lacustrine sediments laid down in and near the margins of a former marine gulf during Cainozoic times. This marine bight, which has been named the Murray Gulf, came into existence in Oligocene times, and from then on to the end of the Pleistocene it was gradually filled with clays, limestones, marls and sands. The thickness of these ranges up to a total of more than 2,000 ft. and they rest upon a depressed basement of older rocks, chiefly Palæozoic granites, schists, sandstones and conglomerates, which have been penetrated in bores. The limestones, which are of Miocene age, are overlain by impervious clays in the Mallee, and are important aquifers for artesian and subartesian water.

The superficial deposits are sands, gypsum and local freshwater ostracodal limestones, of fluviatile and lacustrine origin. The sandy soils derived from these deposits have been heaped by the wind into long regular sand ridges, trending east-west, with areas of irregularly arranged 'Jumbled' sandhills in places. In their virgin state, these sand ridges are fixed by a cover of vegetation, but where this has been cleared, extensive sand drift has since taken place. There is evidence that the regular sand ridges, which have been formed under the action of the dominant westerly and north-westerly winds, have grown in stages. Buried soil horizons of 'travertine' limestone indicate that periods of relatively high rainfall have alternated with drier periods. The present (or immediate past) time appears to be a relatively wet period.

Apart from the minor undulations due to the sand ridges, the surface of the Mallee exhibits broad ridges and troughs, some miles in width, the trend of which varies from north to north-west. These are of tectonic origin, reflecting buried faults or warps in the underlying basement complex. Uplift across the lower course of the Murray resulted in the formation of lakes, which have now been trained, and in these and other old lake basins extensive deposits of gypsum, locally known as copi, were laid down. These now constitute an important source of this mineral.

OBITUARIES

Dr. W. J. Mayo

TO the surgeon, and especially to the surgeon in the United States of America, the death of Dr. W. J. Mayo on July 28 at the age of seventy-eight years is a major historical event. Born in 1861, in the State of Minnesota, he spent his life and did his work in the small country town of Rochester; and there with his brother Charles, who died two months ago (see NATURE of July 15, p. 103), he built up the Mayo Clinic the expansion of which has been very great. In early life he conceived the idea that patients could best be treated by groups of medical men among whom could be found specialists in every disorder. This idea was revolutionary at the time; and although in operation it may best be suited to American conditions, not only did it underly the practical success of the Mayo Clinic, but it has also influenced wider opinion because medical men from all over the world were attracted to the experiment. In Rochester was to be found an organization almost fanatically devoted to the interest of the patient, to the exclusion both of financial considerations and of personal professional renown. For from the beginning of the clinic part of its profits were set aside to be devoted to research not only in clinical subjects and the fundamental clinical sciences, but also in such related sciences as chemistry and physics. The two brothers and their early collaborators deliberately sacrificed wealth; and chose to regard as their reward the knowledge that their Institution was making substantial contributions to medical progress. As funds accumulated they were to expand their efforts, always governed by the same general principles, to postgraduate education; and their system of training young men broadly and encouraging specialization only after a sound basic experience has been watched with interest by the medical academic world, and has frequently been utilized by medical schools both in America and in Europe; for one of the many

excellences of the clinic has been its readiness to expound its technical methods and the results obtained by them to visitors of any nationality. There is no doubt that the inception and later the guidance of this great experiment in group practice were controlled by Dr. Mayo; and the success which has attended his aims stamps him as a man of singular vision, broad outlook, indomitable perseverance, possessed of administrative powers of the highest order.

In the practice of his craft, Dr. Mayo was in the first rank. His personality and sincerity at once gained and ever afterwards retained the confidence of his patients; as an operator he could be cautious or bold as the occasion demanded, and with his enormous experience and thought for individual patients those who worked with him came to rely implicitly on his surgical judgment. His chief interests lay in the surgery of the alimentary and biliary tracts, and to these he made many substantial contributions. He was sedulous in promoting the advancement of surgery in the United States, and to this end interested himself actively in the founding and governing of the American College of Surgeons and the American Surgical Association. This disinterested devotion to surgery was honoured by learned bodies all over the world.

As must men whose energies are devoted to the control of great enterprises, he kept himself somewhat apart. But he was a warmhearted and generous helper of his juniors, for he knew better than most, and lived to see himself right, that to justify his conceptions the organization which he built almost with his own hands must live on after he relinquished active control.

J. R. LEARMONTH.

Prof. R. W. Reid

PROF. ROBERT W. REID, emeritus regius professor of anatomy in the University of Aberdeen, the Nestor among British anatomists, died in Aberdeen on July 28, aged eighty-eight years. He was born in the manse of Auchindoir, Aberdeenshire, in 1851, and after graduating in medicine in the University of Aberdeen, became demonstrator of anatomy in St. Thomas's Hospital, London, in 1873, being almost the first medical man to be attached to a London hospital as anatomist. In 1889, he succeeded Sir John Struthers as professor of anatomy in the University of Aberdeen. He held this chair for thirty-six years, retiring in 1925.

Reid was the sole survivor of the anatomists who founded the Anatomical Society in 1887; he became president of the Society in 1910. He was elected a fellow of the Royal Anthropological Institute in 1886. His first important contribution to anatomy was entitled "Observations on the Relation of the Principal Fissures and Convolutions of the Cerebrum to the Outer Surface of the Scalp"; this appeared in the *Lancet* of September 27, 1884, and it contains a description of a base line—spoken of to-day as "Reid's Base Line". Two other important papers on topographical anatomy were published by him in the *Journal of Anatomy*—one on the relationship of nerve roots to vertebral markings; the other on the position of the chief nerve trunks.

Soon after being appointed to Aberdeen, he established in connexion with his department an anthropological bureau to register the physical characters of the students who entered and to keep a record of their growth changes. Reports from the valuable data thus collected have appeared in the *Journal of the Royal Anthropological Institute*. Records are still being kept, and no doubt will provide the material for further papers dealing with the anthropology of the Scottish student. Another great service he rendered to the prehistory of Scotland by the preservation and study of the remains of the strange people who first appeared in Aberdeenshire early in the second millennium B.C. His own physical features were so similar to theirs that one had reason to regard him as a descendant of these early Bronze Age settlers in the north-east part of Scotland. The Anthropological Museum of the University of Aberdeen, in which these unique specimens are preserved, owes more to Prof. Reid than the "Illustrated Catalogue of Specimens from Prehistoric Interments found in the North East of Scotland" which he wrote in 1924. In acknowledgment of what he did for this Museum and for the University, his friends and pupils endowed a lectureship in connexion with it—known as the Reid Lectureship. He was the moving spirit and the purse-bearer—that brought into existence the Anatomical and Anthropological Society of the University of Aberdeen. In person he was retiring, almost morbidly modest, charitable and very hospitable.

Dr. W. A. Potts

LT.-COL. WILLIAM ALEXANDER POTTS, who died on July 23 in Birmingham at the age of seventy-three years, was a familiar figure to those interested in psychological medicine and latterly also to those interested in criminology.

Potts started his scientific career at the East Riding Mental Hospital, Beverley, but left this branch of work to go into general practice, where he remained for fully twenty years. After this he became medical adviser to the Birmingham Mental Deficiency Committee and so his more scientific side became concentrated on the mentally defective. Since 1919 he had been very helpful in an advisory capacity to the police courts in Birmingham, particularly when they were dealing with cases of mental deficiency. He was also medical adviser to the Barr Park Colony and consultant to the Royal Albert Institution. He was chairman of the Special Schools After-Care Committee in Birmingham. He carried out a considerable amount of work lecturing and teaching, and collaborated with Shuttleworth in his "Mentally Deficient Children".

He was a most charming personality and always had a ready smile and a helping hand for the young men.

WE regret to announce the death of Mr. H. P. Hollis, a former president of the British Astronomical Association, on August 7, aged eighty-one years.

NEWS AND VIEWS

Prof. F. Vejdovský

DESPITE the disturbed political situation and international tension, Czech men of science and their friends intend, if possible, to celebrate next October the ninetieth birthday of one of Bohemia's most distinguished living sons, Prof. František Vejdovský, who was born on October 24, 1849. After studying at the Charles University of Prague, and already as a young man winning fame as a zoologist, he was elected professor of zoology, comparative anatomy and embryology in the Charles University in 1892,

PROF. F. VEJDOVSKÝ

retiring as professor emeritus in 1921. During his long life, Vejdovský has not only been very active as a teacher and leader among Czech zoologists, he has also, by his own researches and those of his numerous pupils, contributed largely to the advancement of many different branches of zoology. His own work covers a very wide field, but it has dealt mainly with the morphology, development and systematics of various Invertebrata, and with cytology—especially spermatogenesis, fertilization and problems connected with the centrosome and the chromosomes. On these and other matters he has published some ten large treatises, and more than a hundred other memoirs in Czech, English, American, French and German periodicals.

IN his own country, Prof. Vejdovský has long been held in the highest esteem, and his accomplishments and his personal kindliness have endeared him to a wide circle of friends and correspondents abroad. Few men attain the age of ninety years, and fewer still can look back upon so long a lifetime spent in the wholehearted pursuit of science for its own sake. Prof. Vejdovský has lived through the classical periods of Darwinism and Mendelism, and has actually seen the rise of modern cytology—to which he contributed an honourable share—and he has hitherto survived the prolonged ordeals which his nation has suffered during this century. All true men of science everywhere must therefore offer him respectful congratulations on his approaching birthday, and wish him and his people that peace and future happiness which, by their steadfast devotion to science and civilization, they so richly deserve.

Petrus Camper, F.R.S. (1722-1789)

THE fifteenth volume of the *Opuscula Selecta Neerlandicorum de Arte Medica*, which has recently been published under the able editorship of Dr. B. W. T. Nuyens, of Amsterdam, contains the illustrated travel diaries in Dutch and English of the three visits to England made by Petrus Camper, who was not only one of the most eminent Dutch medical men in the second half of the eighteenth century, but was also a botanist, zoologist, mineralogist, palæontologist and draughtsman of distinction. The first visit, in 1749, three years after his qualification, was chiefly undertaken for the purpose of attending the lectures of William Smellie, the father of British gynæcology, and of taking lessons in drawing at the Royal Academy. During his stay in Great Britain he made the acquaintance of many of the leading scientific men of the day, including Sir Hans Sloane, Sir Joseph Banks, F. W. Herschel, John and William Hunter, John Smeaton, Mead and Cheselden. He attended the meetings of the Royal Society, of which he was made a fellow in 1750, visited the hospitals and museums and showed the keenest interest in contemporary scientific novelties. He did not confine his attention to London, but visited Oxford, Cambridge, Bath, Bristol and Birmingham, where he made the acquaintance of Withering and James Watt. In the next two visits which he paid in 1752, when he was professor at Franeker, and in 1785, a few years before his death, his energy and enthusiasm still appeared to be unabated, and his time was profitably spent in a congenial scientific atmosphere.

New Technical Branch for the Royal Air Force

OFFICIAL confirmation was given recently of a decision to form a separate technical specialist branch of the Royal Air Force. It has become increasingly obvious that, owing to the technical complexity of the problems relating to service aircraft and their equipment, it is necessary to allocate personnel to engineering and technical duties, allowing them to devote their whole time to such work and arranging various courses of training for them. Up to the present, the policy of the Royal Air Force

has always been that all officers must enter the "General Duties Branch", and devote their time to a complete training in flying for, at least, many years of their time as junior officers. Later they can express a wish to take up specialization in technical work, but they are still required to maintain proficiency in flying. Thus the process of becoming a technical specialist is a slow one, and in a service in which the retiring age is, possibly necessarily, set fairly early, as flying is primarily a young man's job, the officer choosing these branches always finds himself at a disadvantage, either for promotion within the service, or in respect of his ability to obtain employment in the technical side of aviation upon retirement. Also the break in continuity of training and accumulation of experience is usually considered to be unwise, and many young engineers, both from the universities and works apprenticeships, have undoubtedly been deterred from entering the Royal Air Force by this reason.

In spite of the enthusiastic membership of the university air squadrons the number of technical graduates offering themselves for University Commissions in the Royal Air Force has always been relatively small. The new branch should remove these disadvantages. Entrants for commissions are now offered direct entry into technical work, without having to spend several years in acquiring proficiency in flying. They are to be recruited from university graduates in engineering or natural science, and student apprentices from works who have acquired theoretical knowledge up to a university degree standard. The retiring age limit may well now be extended, as the work is not that in which the younger man necessarily excels, in fact the older man would be superior by reason of his accumulated experience. Prospects of promotion should also now be greater as there must be senior administrative posts within the new department.

Further Archæological Excavation in Syria

Sir Leonard Woolley's third season of excavation on the ancient site of Allalakh at Atchana near Antioch, as anticipated, has enlarged and added further detail to the picture of a great meeting place of the civilizations of East and West at an entrance gate to western Asia; but at its close it held out promise of an even greater field of discovery still to be explored. Of this a glimpse may be afforded when the numerous cuneiform inscriptions retrieved in the season just past have been submitted to inspection. Sir Leonard in his preliminary report (*The Times*, August 2 and 3) opened with an account of the further excavation of the earlier palace, which preceded that of the fifteenth-century Hittite king, Nig-me-pa. This earlier building, cannot, Sir Leonard thinks, be much later than the time of Hammurabi, and he assigns it tentatively to the eighteenth century B.C. The structural features, which point to its use in part for administrative and business purposes, in part as a royal residence, convey the impression of a sense of dignity and propriety, combined with an unusual appreciation of space and air, particularly noticeable in the arrangement of the upper residential chambers, with a loggia giving an extensive view over the city, and an approach by newel stairs, of which the first two flights are nearly perfectly preserved. It was, however, from a private house of the fifteenth century that the much desired further evidence was obtained of the contact with Crete, for which mainly the excavation of Atchana was undertaken. This now took the form of a fresco, which is exactly similar to a scheme of decoration found at Knossos, and a 12-wick lamp in red porphyry in the form of the capital of a column, which at Knossos would be hailed, Sir Leonard says, as a typical, but unusually fine, example of Minoan art.

It was, however, towards the close of the season's work that the most striking discovery was made, which, as Sir Leonard says, "goes far to complete the picture of the ancient city of Allalakh". This was a temple, which throws light upon the religion of the people, and gives examples of their major arts. Though the clearance of this part of the site has only just begun, it is already evident that here are the superimposed remains of at least four temples, of which the latest may date to about 1200 B.C. and the earliest to the fifteenth century. They had been richly adorned with sculpture. Although as yet it has not been possible for Sir Leonard to give more than the most summary of accounts, the record of finds is amazing in both number and interest. Among the more arresting finds are the remarkable sculptured lions, the bronze spearhead, deemed to be a cult object, and most remarkable of all, the hidden statue of a king or god in white limestone with its fifty lines of cuneiform inscription, of which the decipherment will be awaited with keenest anticipation. Such a mass of evidence of the character of Hittite art, and of so early a date—at least of 1200 B.C. and possibly even of the fifteenth century—is indeed an unexpected, but more than welcome find.

Excavations at Ezion-Geber

Recent excavation at Tell el-Kheleifi on the Gulf of Aqabah, Sinai, by the American School of Oriental Research at Jerusalem, not only has confirmed the indications of the importance of this site in early times as a meeting place of a number of trade routes, afforded by investigations in 1938, but also has revealed that it was the centre of an extensive industry for the smelting and refining of copper and iron from the mines of the adjacent Arabah. The site has been identified with the great port of King Solomon, Ezion-Geber "which is by Elath on the shore of the Red Sea, in the land of Edom". No longer, however, does it stand by the sea. The prevailing northerly winds have brought sand to silt up the head of the gulf, so that the shore is now half a mile away. The importance of the city as a commercial centre was indicated in the first season's excavation by a number of finds, of which the most important is held to be a large broken jar, on which

had been incised two letters belonging to the early South Arabic script. This is assigned by stratigraphic evidence to approximately the latter part of the eighth century B.C. The letters are the earliest known to be definitely datable from a scientifically controlled excavation. Dr. Nelson Glueck, director of the School, in a preliminary account of the excavations carried out in May–June, 1939 (*Illustrated London News* of August 5) records the discovery of an ingenious and complicated system of flues and channels in the thick and high walls of sun-dried brick of the first city, which is so constructed as to utilize the draught of the prevailing winds from the north for the furnaces of an elaborate complex of smelting and refining plant—the largest yet discovered in the ancient Near East. This system would appear to have been the governing factor in determining the site for the first city; and so well bonded were the bricks that many of the walls still stand almost at their original height after nearly three thousand years. Among smaller finds from the third city were Egyptian amulets, of which one was a small cat, a form characteristic of the cult of the goddess Bast of Bubastis, and another was the Uzat eye of Horus.

Jenner and Napoleon

AT a recent meeting of the Section of the History of Medicine of the Royal Society of Medicine (*Proc. Roy. Soc. Med.*, 32, 877; 1939), Dr. J. A. Nixon said that the world-wide eminence of Edward Jenner found no better illustration than his ability to secure the liberation of British prisoners from countries with which England was at war. One of the best known of these prisoners was the Earl of Yarmouth, the model of Thackeray's Marquess of Steyne and Disraeli's Marquess of Monmouth, on behalf of whom Jenner addressed in 1803 the following appeal to the National Institute of France: "The Sciences are never at war. . . . Permit me then as a public body with whom I am connected to solicit the exertion of your interest in the liberation of Lord Yarmouth". In 1805 Jenner addressed himself directly to Napoleon requesting that two of his friends, Mr. William Thomas Williams and Dr. John Wickham, both men of science and literature, might return to England. According to Baron, the well-known biographer of Jenner, it was either on this or a similar occasion that Napoleon exclaimed: "Jenner! Ah, we can refuse nothing to this man." Jenner was also successful in obtaining the release of Sir George Sinclair, who had been arrested as a spy at Göttingen. Besides helping to liberate Englishmen detained on the Continent, Jenner issued certificates stating that travellers abroad were known to him and were undertaking a voyage in pursuit of science or health or other affairs entirely unconnected with the war, and were in his opinion entitled to protection and freedom.

British School of Archæology at Athens, 1935-36

ALTHOUGH the Annual of the British School at Athens no longer provides a general view of the activities of the School and its students—information which now must be sought in a separate publication—its contents continue to record the more important operations of its members. The volume for 1935–36 (London: Macmillan and Co., Ltd., 1939. 42*s*. net), however, opens with an account, very fully illustrated, by Dr. Alex. Philadelphus, director of the National Museum of Athens, of the Anavysos Kouros, a remarkable example of archaic art, in fact "one of the most perfect and almost the last link in the long chain of Apollos or kouroi that have come down to us", probably dating at about 530 B.C. This statue, which was recovered in fragments from an antique dealer in Paris, had been smuggled out of Greece by sea a few years ago from Anavysos, near Laurium. Of the remainder of the contents of the volume the greater part is given up to the excavation of the cave of Trapeza on the plain of Lasithi in eastern Crete. This cave was first discovered by Sir Arthur Evans in 1896, who refers to it as containing objects mainly of the Hellenistic period, but also a faience figure of Bes and fragments of gold leaf, which afterwards found a parallel in the Early Minoan jewellery at Mokhlos. Apart from mention by Taramelli and Bosanquet, it received no attention from archæologists until 1935, when it was visited by members of the School. In 1936, between May 4 and 19, it was excavated by Miss Money-Coutts, Mr. and Mrs. J. D. S. Pendlebury and others. Judging from the finds, the contents of the cave originally must have been rich. Although metal was comparatively rare, gold, silver, bronze (or copper), and lead were all represented. The deposits in the cave, however, had been much disturbed by treasure hunters, and in one spot only were they intact. It has, therefore, been possible to study the pottery found for the most part on stylistic evidence only, and to reconstruct the history of the cave accordingly. It would appear to have been occupied as a habitation site in Late Neolithic, and to have been used for communal interment from Early Minoan II until the end of Early Minoan III.

The Cyclotron and Biological and Medical Research

DR. G. E. HARRISON, lecturer in physics, in the University of Birmingham, has been elected to a Rockefeller Foundation fellowship in natural science which will enable him to spend a year at Berkeley University, California, studying under Profs. J. H. and E. O. Lawrence. The object of the visit is to acquire first-hand knowledge of the application of neutrons to biological and therapeutic research, in which the Profs. Lawrence have opened up a new field the exploration of which seems likely to be of first-rate importance in the treatment of disease. Berkeley University, where Prof. Lawrence constructed his cyclotron and has developed his own technique, is unique in facilities for the production of neutrons and artificial radioactive substances. When the large cyclotron which Prof. Oliphant is building for research in nuclear physics in the Physics Department of the University of Birmingham is completed, this University, in which the Physics Department and new Medical School are in close proximity, will

be in an exceptionally favourable position for the promotion of the therapeutic and physiological investigations which Prof. Lawrence at Berkeley and Prof. Hevesy at Copenhagen have so strikingly originated. It is hoped that on his return from California, Dr. Harrison will organize and direct research in these subjects in the University of Birmingham.

The Ontario Research Foundation

THE report of the Ontario Research Foundation for the year 1938 (Sessions Paper, No. 48, 1939. Pp. 36. Toronto: King's Printer, 1939) refers to the extension of the soil survey of the central part of Southern Ontario eastward to the Quebec border. The Department of Agriculture has also determined the general relations between the performance of certain varieties of apple, and climatic and soil conditions in the apple-growing sections of the Province. The Department of Pathology and Bacteriology has continued its studies of bovine mastitis. Attention has been focused on the prevention of human infection by pasteurization of milk, and experimental work was continued during the year on *Brucella Abortus*. Studies relating to the sheep nose fly were continued during the year as well as on the parasites of game and fish. The Textiles Department has been responsible for investigations on causes of fabric fraying and the quantitative and consistent measurement of this tendency. They have also been responsible for testing work on the fastness to light of dyestuffs used in the Canadian textile industry, and have commenced a study of the fundamental and physical characteristics of single silk fibres. The testing work and control work of the department, particularly in connexion with rayon merchandise, have also increased. The facilities of the Department of Engineering and Metallurgy for the investigation of products associated with air-conditioning have been extended, and were put to considerable use in the year. A study of the resistance of metals and alloys to abrasion and wear has developed to a stage which permitted a new programme of work to be prepared, and results of tests on suitable metals have been collated.

THE Department of Chemistry in its investigation of paint failures in the Paint and Varnish Laboratory has continued to yield information essential to understand the problem of protective finishes, and a fundamental investigation of the processing of drying oils is in progress. Other work on a low cost plastic moulding powder prepared from wood meal has overcome the difficulties due to the absence of some properties which are essential to commercial success, and a low cost powder is now available which can be moulded commercially. Interpolymerization of styrene and other organic chemicals has been studied in the cellulose and plastics laboratory and a new series of interpolymers developed which are notable in their resistance to swelling in commercial solvents. During the year an Analytical Laboratory was established to serve as a central laboratory in the Foundation for analytical problems. The Paper, Printing and Adhesives Laboratory has worked mainly on packaging and adhesive problems due to difficulties through odours and moisture. In the Department of Biochemistry work on the production of lactic acid and other chemicals by the action of micro-organisms has been conducted, as well as pilot scale tannery operations to improve the vegetable chrome process for the manufacture of sole and belting leather which was developed in 1937, and in addition to improving the colour of the leather it is hoped to improve still further its durability under normal wearing conditions. Attention is also being given to the development of spue on finished leather, and a complete report on the technology and economics of pectin production has been prepared for one of the large apple growers of the Province.

"Nomenclator Zoologicus"

WE have received a sample part of the "Nomenclator Zoologicus", edited by Dr. S. A. Neave, of which the first volume is about to be published by the Zoological Society. The work, which will be completed in four volumes, aims at giving "as complete a record as possible of the bibliographical origins of the name of every genus and subgenus in zoology published since 1758, the date of the tenth edition of Linnæus' 'Systema Naturæ', up to the end of the year 1935". Up to 1850, not only the generic but also the specific names are indexed in Sherborn's monumental "Index Animalium". Since that date, however, the scale of zoological publication has increased so vastly that a continuation of "Sherborn" would be a task of overwhelming magnitude. Even in the all-important matter of generic names the systematist has been compelled to spend much time and labour in tracing their origin and in trying to avoid re-inventing old names for new genera. The "Nomenclator Animalium generum et subgenerum" published by the Prussian Academy of Sciences, begun in 1926, was designed to remedy this state of affairs, but it has been making its appearance in so leisurely a fashion that, although already thirteen years out of date, it is not yet completed. Dr. Neave, who has had the assistance of the specialists on the staff of the British Museum (Natural History), as well as of many other zoologists in Great Britain and abroad, hopes to complete publication by the end of 1940. Apart from cross-references and variations in spelling, he and his collaborators have collected about 192,000 generic names, of which at least 5,000 have escaped inclusion in former nomenclators and in the "Zoological Record". No doubt many omissions remain to be discovered, and zoologists are asked to send a note of any they may find so that they may be included in a supplementary list at the end of the last volume.

Forestry in South Africa

WE welcome the issue of the first number of a new forestry publication appearing in the *Journal of the South African Association* (No. 1, Oct. 1938, Pretoria, published by the Association, April and

October, 1938). The number opens with a fitting memorial to the late Mr. J. P. Bekker, administrator of the Transvaal, who was keenly interested in forestry, and one of the earliest advocates of extensive afforestation in the Transvaal. The most important article, which alone would make this number of the *Journal* of high value, is the "Historical Sketch of the Development of Forestry in South Africa" by N. L. King, chief management officer, Division of Forestry. To those interested in forestry progress in the Dominion, a perusal of the paper is recommended. There is a strange omission, however. The author, although he alludes to the early settlers who landed at the Cape in 1652, makes no reference to the fact that they imported in the seventeenth century the oaks and poplars.

THE new journal contains several articles of technical interest to South Africa. In connexion with the important questions of erosion and desiccation in Africa, now receiving serious attention, the brief note, accompanied by some startling photographs, by Colonel Deneys Reitz, M.P., on "The Forests of Northern Zululand" is arresting. Colonel Reitz depicts areas of forest which he knew fifteen years ago with the present state of affairs. "In those days this area consisted of open savannah plains plentifully interspersed with park-like groves of timber. In addition there was the extensive Mongosi Forest and several other valuable forests at Mpatu, Moosi and elsewhere. . . ." The author shows that the greater part of the groves and the forest areas have now disappeared to make 'gardens', that is, cultivation. Among other articles of interest is one by F. S. Laughton on the "Raising of Transplants of Indigenous Tree Species for Open-Rooted Planting" and a paper by S. P. Sherry entitled "The Rate of Growth and Health of the Southern Pines in the Midland Conservancy".

Control of the Chrysanthemum Midge

A LAW case of interest to chrysanthemum growers was heard at Littlehampton on July 3 when a nurseryman was prosecuted by the Ministry of Agriculture and Fisheries for failure to comply with a notice requiring him to take certain measures for the extirpation of the chrysanthemum midge from his premises. The chrysanthemum midge is a serious pest of greenhouse chrysanthemums in North America, and during the past two years it has been found to exist in a few nurseries in England. The control measures to be adopted, if the pest became established in Great Britain, would add greatly to the cost of growing chrysanthemums. For this reason drastic measures are enforced with the view of eradicating the pest where it has been found and preventing its spread to other nurseries. It is in the interests of all that outbreaks should be speedily discovered and notified to the Ministry. Growers of chrysanthemums are advised to watch their plants carefully and to send to the Ministry specimens of plants attacked by any insect with which they are unfamiliar. An illustrated leaflet (Advisory Leaflet No. 286), which gives a full description of the chrysanthemum midge and its habits, may be obtained on application to the Ministry at 10 Whitehall Place, London, S.W.1.

Modification of the Steiner Composting Process

THE present-day shortage of organic fertilizers has naturally led to special attention being paid to methods of composting. Recently a claim has been put forward by Miss Maye Bruce, of Sapperton, Gloucestershire, that she has developed a modification of the Steiner process which results in a more rapid decomposition of the waste material and a more valuable product from the fertilizing point of view (*J. Min. Agric.*, **46**, No. 3, 295; 1939). A layer of charcoal is spread over a foundation of rubble, and a wall, about 4 ft. high, of wood or brick built round it. Garden refuse of a non-woody nature is then thrown on, particular value being attached to stinging nettles. Unslaked lime is sprinkled when the first and third foot levels are reached and animal manure, if available, is applied at the second foot level. The unique part of the method, however, lies in the recommendation that the further addition of six herbal essences, namely, nettle, yarrow, camomile, valerian, dandelion and oakbark, together with pure run honey, in a solution of 1 part in 10,000 adds greatly to the value of the compost. The heap should be covered with about 6 in. of soil and protected from rain, and after six weeks in summer, or twelve in winter, the refuse becomes a rich, friable and sweet smelling heap of compost. Further information as to how to make and use these essences can be obtained from Miss Bruce, who is also willing to forward them at a nominal charge to cover packing and postage.

Electric Heating of Domestic Hot Water Supply

THE important paper on "The Application of Electric Heating to Domestic Hot-water Supply Systems" read to the Institution of Electrical Engineers and to seven local centres is published in the *Journal* of the Institution of July. In the discussion, Mr. A. E. McKenzie, engineer to the Wimbledon Corporation, said that in the three towns supplied by his undertaking, there are 38,000 consumers taking electricity and 17,633 electric water heaters. This gives one water heater for every 2·15 houses, or approximately 46 per cent saturation. In addition, there are a large number of publicly owned heaters. In Wimbledon, all self-contained water heaters are cleaned out once in two years, and four improvers are employed continuously on this work. All the heaters in a street are cleaned at the same time, thereby cutting maintenance costs down to a minimum. Taken over a period of years, the cost of cleaning such heaters, both large and small, averages 1*d.* per month. As the numbers increase, it is hoped that this cost will soon fall. The problem of 'scaling' is more serious with the small heaters than with the big ones. Most of the scale is deposited at the top of the outlet pipe and at the anti-dripping device which is immediately over it. There is no necessity to remove any of the electrical connexions. This enables the heater to be renovated

in less than half the time and at less than half the cost formerly necessary. A strong case can be made out for the claim that the electric water heater is more trustworthy than any other type. At Wimbledon there are 5,000 of the self-cleaning type installed and there has not been a failure. Serious accidents due to electric water heaters are practically unknown. During the severe weather last winter, only twelve heaters were put out of action, all of which functioned immediately the ice was melted in the supply pipes.

A Californian School of Education

To have directed one of the foremost schools of education in the United States from 1898 until 1933, to have presided during those thirty-five years over the training of nearly three thousand of the graduates whom it has sent out to all parts of the United States and beyond, many of them to occupy strategic positions in the educational world as professors, research workers and school and college executives, and to crown this life's work by presenting it with a new 500,000-dollar building paid for out of the proceeds, judiciously invested, of spare-time earnings during all those years—to few is it given in their declining years to look back on so satisfying an achievement. It is commemorated in a pamphlet recently issued by Stanford University in connexion with the opening of the University School of Education Building—the gift of Dean (emeritus) Cubberley and his wife. A noteworthy feature of the School since the Great War is the importance of the summer quarter, during which most of the students are school executives or teachers, contacts between whom and the School faculty have proved highly stimulating. The summer is indeed regarded as the most important quarter of the university year for instruction in the field of education. The delightful summer climate of the Santa Clara Valley is one of the School's most valuable assets. An article by the present Dean emphasizes the conception that professional study in education should have a foundation of scholarship in the social studies and in psychology and human biology. "The school has been one of the most static of the social institutions. . . . University schools of education have responsibility for developing new conceptions and techniques of education which are more adequate for modern society," so that the school system may develop in the people "the vision, the creativeness, the initiative, the critical-mindedness, the understanding, and the discipline which will . . . give expression to the democratic social ideals."

Museums of Norwich

THE Museums Committee of the City Council has just issued a report covering ten years' development (1929–1938) in the museums of Norwich. It has been a period of noteworthy progress, partly on account of the value and number of gifts and bequests made to the museums, but mainly on account of the advances made in museum arrangement and appeal. The exterior and amenities of the Castle Museum, with its Norman keep and magnificent Norman doorway, have been attended to following the advice of H.M. Office of Works, and great reorganization has taken place in the collections exhibited within. It was a wise move to reduce the excessive space formerly given to exhibits, often reduplicated, of British birds, in order to allow a more balanced representation of the animal kingdom; and the creation of dioramas of representative stretches of Norfolk scenery with the appropriate flora and fauna adds greatly to the instructiveness and attraction of the collections. In the Art Galleries the valuable paintings of the Cotman period are undergoing restoration where this has been found to be desirable, and a scheme of redecoration has been followed by successful experiments in the rearranging of the pictures themselves. In other directions the museums show that they are keeping in pace with modern developments, and none of these is more gratifying than the success of the collaboration with the Education Authority for regular visits of school classes to the various museums.

Public Health Statistics of India

THE annual report of the Public Health Commissioner to the Government of India for 1936, in two volumes, has recently been issued (Government of India Press, New Delhi, 1938. Vol. 1, Rs. 2, or 3*s*. 6*d*.; vol. 2, Rs. 1, annas 10, or 2*s*. 9*d*). The state of the public health of the civil population in British India is surveyed in vol. 1. The mid-year estimated population was 281,866,639—an increase of 3½ millions over 1935. The death-rate was 23, and the birth-rate 35, per 1,000, and the infantile death-rate per 1,000 live births was 162, compared with 164 for 1935. The deaths from cholera numbered 160,000, some 57,000 less than in the previous year, and those from plague were only 13,000, less than half the figure for 1935; but the deaths from smallpox numbered 104,805 or 14,000 more than in the previous year. Deaths recorded under 'fevers' decreased by 4 per cent, but small percentage increases were recorded in respiratory diseases and the diarrhœa and dysentery group. Deaths recorded from hydrophobia numbered no fewer than 2,470. In vol. 2, the general health statistics of the British Army in India and of the Indian Army are considered. The general health of the troops seems to have been well maintained, though admissions to hospital among the British were a little higher than in the previous year. The incidence of the enteric group of fevers is the lowest ever recorded, and is particularly striking among the Indian troops. There has been no corresponding reduction among the civil population, but rather an increase. The decrease of enteric fevers in the Army must, it would seem, be ascribed to more general and better anti-typhoid vaccination, and to a more careful search for, and elimination of, carriers.

Child Welfare Organization

THE League of Nations has published the annual report on child welfare prepared by the Child Welfare Information Centre (London: George Allen and

Unwin, Ltd., 4*s*.). The report gives *inter alia* a general account of the measures adopted in China, with a summary of the work being done in the province of Kwang-si, the most advanced province as regards the organization of social services. Information on the United States and the United Kingdom is very complete. The report should prove useful to all who are interested in the social development of various countries and the measures adopted to protect the mother and child.

Safeguarding Water Supplies

A MEMORANDUM setting out the precautions necessary in the administration of a water supply undertaking in order to maintain the wholesomeness of the supply has been sent by the Minister of Health to all water undertakings ("Memorandum on the Safeguards to be Adopted in Day to Day Administration of Water Undertakings". Mem. 221. H.M. Stationery Office). These precautions are those that have long been recognized as good practice in water administration, and include care in the selection of workmen so as to exclude possible infection through carriers, particularly during repair work, inspection of gathering grounds, frequent and regular analyses of the water supplied, and the use of special treatment such as chlorination.

Research in the London Hospital

THE Publications Committee, with Prof. Bedson as its secretary, has issued a volume of "Researches Published from the Wards and Laboratories of the London Hospital during 1938" (London: H. K. Lewis and Co., Ltd., 7*s*. 6*d*. net). It includes thirty-seven papers dealing with a wide range of subjects—physiological, pathological, biochemical and clinical—which are evidence, if that were needed, of the active studies upon problems of health and of disease that are being pursued at this great medical school and hospital.

Studentships and Fellowships in Medical Research

THE Medical Research Council invites applications for a fourth series of studentships and fellowships intended to encourage young British medical graduates towards becoming investigators in those branches of medical science which are concerned directly with disease as it occurs in human beings. Post-graduate studentships are offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive a stipend at the rate of £200 per annum, during a period not exceeding twelve months, for personal maintenance while undertaking approved courses of study in Great Britain such as may be regarded as best calculated to advance the student's training in methods of research. Research fellowships are also offered for candidates of similar qualifications who have already had some experience in the use of research methods. Each fellowship will be tenable for one year at the ordinary value of £250 per annum, and will be renewable in approved instances at the rate of £300 per annum for a second year. These fellowships are intended as probationary appointments for research in clinical science or experimental pathology under suitable direction in Great Britain. Research expenses may be provided in addition to stipend. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, London, S.W.1.

Announcements

PROF. A. J. Clark, professor of materia medica in the University of Edinburgh, and Prof. T. R. Elliott, emeritus professor of medicine in the University of London and consulting physician to University College Hospital, have been appointed members of the Medical Research Council, in succession to Prof. H. S. Raper and Prof. J. A. Ryle, who retire in rotation on September 30.

DR. DEAN BURK, formerly chemist in the Bureau of Chemistry and Soils, U.S. Department of Agriculture, has been appointed senior chemist in the newly established National Cancer Institute, U.S. Public Health Service, and associate professor of biochemistry at Cornell University Medical College in New York City, where a study on tissue metabolism fundamental to cancer will be carried out under the auspices of a grant made by the National Advisory Cancer Council to the Department of Biochemistry headed by Prof. Vincent du Vigneaud. Collaborating in the investigations will be Dr. Fritz Lipmann, formerly research associate of Prof. Otto Meyerhof and of Dr. P. A. Levene of the Rockefeller Institute, and lately with Dr. Albert Fischer at the Carlsbergfondets Biologiske Institut, Copenhagen.

DR. FRIEDRICH KARL KLEINE, honorary professor of hygiene in the University of Berlin and an expert on tropical diseases, has recently been awarded the Shield of Nobility of the Reich by the German Chancellor.

PROF. LUDWIG JOST, professor of botany in the University of Heidelberg, has been awarded the Charles R. Barnes honorary life membership of the American Society of Plant Physiology.

THE Autumn Meeting of the Iron and Steel Institute will be held in Cardiff during September 12–15. Further information can be obtained from the Secretary, Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W.1.

THE John Burroughs Association desires to get in touch with organizations throughout the world which have been formed in honour of John Burroughs, the American poet and naturalist, with the view of collecting opinions concerning an annual publication containing reports of such organizations and articles on Burroughs. Communications should be addressed to the president of the Association, Dr. Clyde Fisher, American Museum of Natural History, 77th Street and Central Park West, New York City.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 291.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Heavy Cosmic Ray Particles at Jungfraujoch and Sea-Level

THE heavy ionizing particles in the cosmic rays are so rare that it seems unlikely that much information can be obtained from experiments with cloud chambers. The only method at present available which can yield quantitative results is the method of direct photography, which has been used recently by several investigators mainly for investigating the nuclear disintegrations which the cosmic rays produce[1,2]. On a plate which has been exposed for a sufficiently long time is observed, in addition to a great wealth of phenomena associated with disintegration effects, a large number of single tracks probably due to protons or slow mesotrons.

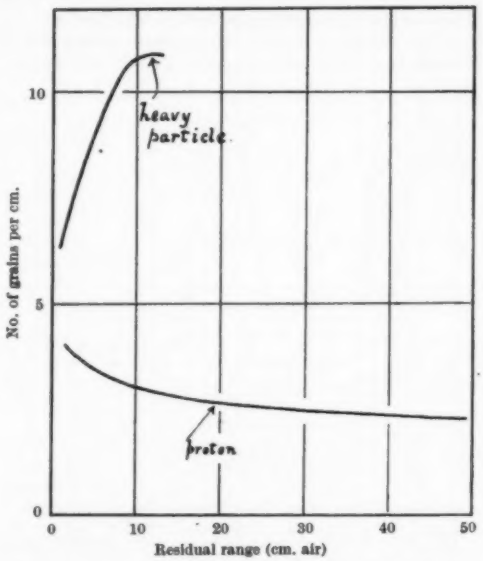
In approaching the problem of elucidating the various processes taking place, the first question which presents itself is that of the nature of the primary radiation responsible for the heavy tracks, and we have therefore made absorption measurements in lead and air. A set of Ilford half-tone plates (emulsion 70 μ thick and sensitive to α-particles and protons), covered with different thicknesses of lead, have been exposed to cosmic rays on the Jungfraujoch and in Bristol for a period of 230 days. We divide the observed tracks into two classes according to their length (that is, the length of the part of the track appearing in the emulsion): (i) tracks less than 10 cm. air equivalent and (ii) tracks greater than 10 cm. air. A large fraction of (i) is due to radioactive contamination, whereas all the tracks (ii) are of cosmic ray origin. The results are given in the following table:

	No. of tracks greater than 10 cm. air per mm.²	No. of tracks less than 10 cm. air per mm.²
Jungfraujoch, no lead	6·2 ± 1·0	20 ± 1·4
5 cm. „	8·4 ± 1·0	27 ± 2·0
13 cm. „	4·5 ± 1·0	16 ± 1·5
Bristol, no lead	0·6 ± 0·2	11 ± 1·5
13 cm. „	0·25 ± 0·2	14 ± 2·0

It will be seen that radiation primarily responsible for the long tracks suffers practically no absorption in lead but is strongly absorbed in air. The short tracks also indicate that the primary radiation giving rise to them is strongly absorbed in air but not in lead. (Probably most of the short tracks on the Bristol plates are of radioactive origin, and we must expect an equal number of this origin in the Jungfrau plates.)

The results show that the *long tracks are neither produced by the electron nor by the mesotron component.* Electrons would be strongly absorbed in lead, whereas the mesotron intensity increases only by a factor 1·7 between Bristol and Jungfraujoch. *The heavy tracks are therefore produced by a third component.* It seems likely that this third component consists of *neutrons*. Further support for this view is given by the experiments of Schopper[3]. Experiments with paraffin as absorber are in progress.

The grain spacing of the tracks is in agreement with that of artificially produced protons. Most of the long tracks are probably protons; but it cannot be excluded that some of the shorter tracks due to cosmic rays are also α-particles, since on the half-tone plates there is little difference between the grain spacing of α-particles and protons. The distribution of tracks was found to be more or less isotropic. The plates were placed in a horizontal position, but no appreciable preponderance of vertical tracks was observed.



We have also observed numerous disintegration stars which will be the subject of a later investigation. Here we only wish to mention one particular case, similar to a heavy particle in a disintegration star observed by Schopper and Schopper[3], which is of interest in connexion with the question of nuclear fission. The star in question has five tracks: four of them are comparatively short (5–11 cm. air) proton or α-ray tracks. The fifth track is 14 cm. long and has an average grain density of about *three times* that of α-rays of 8 cm. range. Considering that there is very little difference between the grain density produced by protons and α-particles of the same range, we must ascribe this track to a heavy particle with a *very high effective charge*. Moreover, the grain density does not increase steadily towards

the end of the range, as is the case for α-particles, but has a maximum at the beginning of its path and then decreases slowly, until at the end of its range it approaches that of an α-particle (see accompanying diagram). This effect is presumably due to capture of extra nuclear electrons.

We do not think it very likely that this track represents the mere recoil from the original cosmic ray particle. The recoil tracks in even very energetic disintegrations are very short, and besides, there is no reason why the recoil nucleus should have such a high effective charge. In all probability we are dealing here with a heavy, highly charged splinter, released by a highly excited heavy nucleus, a process which bears some similarity to the fission of the uranium nucleus.

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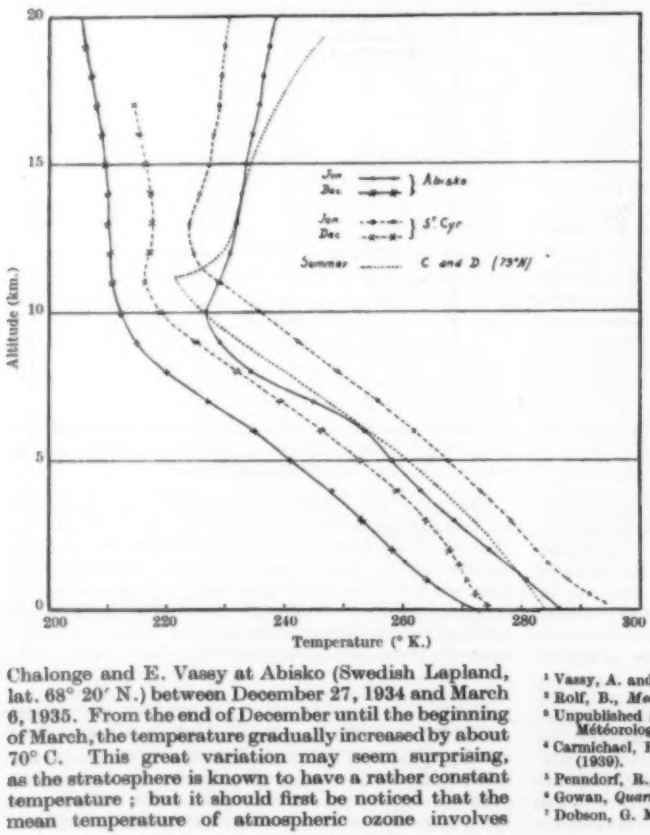
C. F. POWELL.
G. E. F. FERTEL.

H. H. Wills Physical Laboratory, University, Bristol.

[1] Blau and Wambacher, *Sitz. Akad. Wien*, **148**, 623 (1937).
[2] Schopper and Schopper, *Phys. Z.*, **40**, 22 (1939).
[3] Schopper, *Naturwiss.*, **25**, 557 (1937).

Temperature of the Stratosphere in High Latitudes

WE recently directed attention[1] on the variation of the 'mean temperature' of atmospheric ozone, which appeared from the observations made by Barbier, Chalonge and E. Vassy at Abisko (Swedish Lapland, lat. 68° 20′ N.) between December 27, 1934 and March 6, 1935. From the end of December until the beginning of March, the temperature gradually increased by about 70° C. This great variation may seem surprising, as the stratosphere is known to have a rather constant temperature; but it should first be noticed that the mean temperature of atmospheric ozone involves altitudes not accessible to sounding balloons; and next, that the stratosphere has been investigated chiefly in low and middle latitudes.



Rolf[2], however, at Abisko between 1921 and 1929, carried out a long series of measurements showing that above the tropopause the temperature decreases slightly in January, while in June it increases in a regular manner, as may be seen in the accompanying graph.

For the sake of comparison, there are represented on the same graph similar curves deduced from radio soundings made at Saint-Cyr (lat. 48° 47′ N.)[3]. Recently published observations, made by Carmichael and Dymond[4], suggest that this increase of temperature in summer is yet more marked (25° C.) in higher latitudes (about lat. 79° N.).

Thus, direct measurements point to an annual change in the temperature of the stratosphere, and the higher the altitude, the greater the difference between the summer and winter temperatures. In arctic countries, this change is much greater than in lower latitudes. This was also noticed by Penndorf[5].

The measurements of the mean temperature of atmospheric ozone, as they reach much higher regions in the stratosphere, are an extrapolation of the balloon measurements, and strengthen the opinion that this annual variation increases with altitude. Thus the earth's atmosphere offers two arctic zones, by turns very cold in winter and very warm in summer.

Solar radiation would be responsible for these variations. For it is easy to estimate, for a given day, the time when the higher layers of the atmosphere are illuminated; taking also into account the obliquity of the sun's rays, a strong correlation is found between the illumination and the mean temperature of ozone.

In addition, Gowan's calculations[6], though they deal with lower latitudes (50° N.), show a large difference in the higher layers of the stratosphere between the actual temperature and the temperature when the atmosphere is plunged in darkness during a sufficient time for equilibrium to be attained, which is nearly the case in polar night.

One of the consequences of the related phenomenon is a possible explanation, owing to the dependence of the velocity constant of thermal decomposition on temperature, of the decreasing ozone thicknesses at Abisko which are shown by Dobson's curve[7].

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June 28.

[1] Vassy, A. and E., *C.R.*, **208**, 1518 (1939).
[2] Rolf, B., *Med.-Statis. Met.-Hyd. Anstn.*, **5** (1932).
[3] Unpublished material published by courtesy of the Office National Météorologique.
[4] Carmichael, H., and Dymond, E. G., *Proc. Roy. Soc.*, A, 171, 345 (1939).
[5] Penndorf, R., *Veröff. Geoph. Inst., Leipzig*, **8**, 181 (1936).
[6] Gowan, *Quart. J. Roy. Meteor. Soc.*, **62**, Supp., 36 (1936).
[7] Dobson, G. M. B., *Proc. Roy. Soc.*, A, **129**, 411 (1930).

Interpretation of the Red-Shifts of the Light from Extra-Galactic Nebulæ

In his most recent contribution on this subject[1] Hubble mentions a red-shift of + 0·231 A. This corresponds to a velocity of recession of approximately 43,000 miles per second, nearly a quarter of the velocity of light! The conviction grows upon one that these fantastic velocities are not real.

Alternative interpretations of the red-shift have been proposed, but have failed to provide an acceptable explanation. No one has taken account of the fact that a list of the available determinations of the velocity of light shows a steady decrease of velocity with time, following a linear law, $c = 299{,}900 - 3{\cdot}855\ T$, for the epoch 1900[2] (see Table 1).

Table 1.

T	c
1902·4	299,901 ± 84 km./sec.
1924·6	299,802 ± 30
1926·0	299,796 ± 4
1928·5	299,778 ± 20
1932·1	299,774 ± 11
1937·7	299,764 ± 15
1938·5	299,761 ± ?

This may be due to a 'fatigue' phenomenon: there are in Nature no inexhaustible stores of energy, no examples of perpetual motion. There are tremendous stores of energy and the ensuing motion may continue without perceptible alteration for periods almost beyond reckoning, but neither lasts indefinitely. The energy of a photon is not considerable and an explanation of the slowing-down may be sought in a decrease of frequency as the light journeys through space. It may be sought in the fact that the velocity of propagation of a vibration depends on the physical properties (gravitational, electrical, magnetic, atomic, thermal and probably others) of the space through which it is propagated, and that these properties are gradually altering. Whatever its explanation, the slowing-down is an observed fact.

Besides this, a satisfactory interpretation of the red-shifts must conform to the following further observed facts:

(1) Strömberg, by measuring the aberration of light from nebulæ of the Ursa Major I cluster, has shown that the velocity of the light from this cluster is the same as that of light from laboratory sources[3]. Light from all sources, near and far, reach therefore the eye with the same velocity, c.

(2) Planck's constant h is constant, for Adams and Humason[3] have shown that the relation $E\lambda = ch$ (1) holds good for sources of light near and far, by comparing a grating and a prism spectrogram of the emission spectrum of the nucleus of *N.G.C.* 4151.

(3) The wave-length is constant during the light's journey: this assumption is accepted as correct when measuring radial velocities.

(4) The frequency n of a newly generated photon of energy E is the same for all sources of light near and far, since (1) may be written $E = hn$, and it is admitted that the energy of a photon generated by an atom of the same element under the same conditions is the same in all sources near and far. For example, the energy of the photon giving the K line of Ca^+ has the same energy whether generated in a remote nebula or on the earth.

It follows from the above that light leaves a remote nebula with a velocity $c_0 > c$, and a wave-length λ_0 given by the relation $c_0 = n\lambda_0$ (2). During the light's journey, both c_0 and n decrease until, when the light reaches the earth, they have become c and n' respectively, with $c = n'\lambda_0$ (3) and n' is less than n. Since $c_0 > c$, from (2), $\lambda_0 > \lambda$, the corresponding wave-length of light from laboratory sources, and $\lambda_0 = \lambda + d\lambda$, which is the observed red-shift.

In Table 2, m_c is the luminosity of the fifth brightest nebula in each cluster (the clusters are so similar that this gives a precise measurement of distance) and $d\lambda/\lambda$ is the observed red-shift[1]. R is the distance in light years, from the relation $\log r = 0{\cdot}2\ m_c + 4{\cdot}803$; λ_0 is the initial wave-length of the K line of Ca^+, calculated from the red-shift, taking its earth value as $\lambda = 3933$ A.—it is the wave-length at both ends of the light's journey; n' is the frequency of the light from the nebula when it reaches the earth, and c_0 is the initial velocity of the light. The nebulæ are in order of increasing distances. The data relating to Ursa Major II are inconclusive: they have been derived from a single spectrogram of a single nebula only.

Table 2.

Cluster	m_c	$d\lambda/\lambda$	r light-years	λ_0 of K line of Ca^+	n'	c_0
—	—	—	—	(λ = 3933 A.)	(n = 762·2 × 10¹²)	(c = 299774 km./sec.)
Virgo	10·49	0·0041 A.	8 × 10⁶	3949 A.	759·1 × 10¹²	300990
Pegasus	12·88	0·0127	24	3983	752·6	303585
Perseus	13·48	0·0174	31·6	4001	749·1	305030
Coma	14·23	0·0245	44·6	4029	744·0	307090
U. Ma. I	16·12	0·0517	106·4	4137	724·6	315320
Leo	16·33	0·0653	117	4190	715·5	319360
Cor. Bor.	16·54	0·0707	129	4211	711·9	320960
(U. Ma. II	17·73	0·1403	223·4	4485	668·4	341850)
Boötes	17·89	0·1307	240·4	4447	674·1	338950

The slowing down of the frequency and of the velocity both follow linear laws: $n'\ (\times 10^{12}) = 762{\cdot}2 - 0{\cdot}4\ T$; and c_0(Km./sec.) $= 299774 - 173\ T$, where T is in millions of years.

Accordingly, 240 millions years ago, light travelled with a velocity approximately 13 per cent greater than now, and the wave-length of the K line of Ca^+ was 4447 A.

Should the above be confirmed, our measurements of stellar radial velocities will require a correction depending on the distance.

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June 29.

[1] Hubble, "The Observational Approach to Cosmology".
[2] Nature, 120, 602 (1927). A later list of observations appears in *Isis*, 25 (2), No. 70 (Sept. 1927).
[3] Reports Mount Wilson Obs., 1935–36.

Interrelation of Dissociation Energy and Inter-nuclear Distance for some Simple Di-Atoms in Ground States

Having recently suggested[1] that Dr_e^2 (D dissociation energy, r_e internuclear distance) is approximately constant for C—C linkages in solid carbon and in hydrocarbons, I find further that $x = Dr_e^2 n^{1/2}$

(n group number) tends to constancy, within experimental errors, for ground states of simple di-atoms of related type (for example, LiLi, NN and OO).

Using the relation $k_e r_e^5 = pD$ (k_e bond constant, p a constant product for di-atoms of related type[2]), it follows that $k_e r_e^5 n^{1/2} = px$. Fox and Martin[3] find $k_e r_e^5$ constant for C—C linkages: further examination shows that it also connects ground and excited states of the di-atom CC. In general, however, $k_e r_e^5$ seems more useful for correlating different states of a given di-atom, and this is suggested by the Morse-Clark function, which leads to $k_e r_e^5 n = py$, where $y = Dr_e^4 n$, for cases where the reduced mass does not vary greatly. This relation between k_e and r_e is essentially that already used with some success for hydrides and deuterides[4], and conforms with a suggestion made by Sutherland[5], to meet a well-known difficulty which appears in the Morse-Clark expression in the case of isotopic forms. The function y is closely constant in the KH period, where the reduced masses are nearly alike. For HH, HD and DD, x and y give equally concordant results.

Whilst x (or y) appear sensibly constant in appropriate periods, p is more susceptible to change in electron configuration: thus in ground states p(LiLi,KKss) = 9·9, p(OO,KKpp) = 20·9, while $x = 30{\cdot}7$ volt A.^{3} very nearly in both cases. Fox and Martin[3], in agreement with this, find $p = 20{\cdot}7$ for C—C linkages (KKpp type). However, for a given configuration in a given period of di-atoms, p varies with x (or y) in such a way that px (or py) is sensibly constant for excited as well as ground states, and may be equated to period constants of the type K_{qr}.

It is hoped that reliable and more general relations connecting D, k_e and r_e may emerge from this. The detailed results of calculation will be submitted for publication elsewhere.

I am indebted to Dr. J. J. Fox for much helpful discussion.

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July 3.

[1] Clark, C. H. D., NATURE, **143**, 800 (1939).
[2] Sutherland, G. B. B. M., *Proc. Ind. Acad. Sci.*, **8**, 341 (1938).
[3] Fox, J. J., and Martin, A. E., *J. Chem. Soc.*, 884 (1939).
[4] Clark, C. H. D., and Stoves, J. L., *Phil. Mag.*, (vii), **27**, 389 (1939).
[5] Sutherland, G. B. B. M., *Ann. Rep. Chem. Soc.*, 46 (1938).

Differential Threshold for Compression Modulus

WE have recently described[1] experiments in which it was shown that individuals differed but slightly in their capacity to distinguish by touch small differences in viscosity of highly viscous true fluids, and that an 80 per cent level of correct judgments corresponds to a viscosity difference of about 30 per cent.

We have now carried out similar experiments with rubber cylinders in which the compression modulus varied slightly*, the subjects being asked, as in the viscosity experiment, to select the 'softer' of two samples. For the rubber cylinders there are significant differences between individuals (χ^2 method) and further, those of our subjects regularly engaged in routine testing are superior as a group. Less educated and younger subjects are also superior, but it has not been possible to distinguish the separate effects of education and age.

Taking the results for all ten subjects together, our data may be summarized as follows:

	Pairs differing in compression modulus by: per cent (means)					
	1·47	2·74	5·56	9·59	10·59	12·62
Per cent correct	35	49	72	81	85	90
„ given as equal	25	20	11	11	5	2
„ given in reverse order	40	31	17	8	10	8

It will be seen that an 80 per cent level of correct judgments corresponds to a modulus difference of about 9 per cent, so that we conclude that differences in compression moduli of approximately solid materials can be judged subjectively about three times as accurately as can differences in viscosities of highly viscous fluids.

Details will be published elsewhere.

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* The cylinders were manufactured for us by the Research Association of British Rubber Manufacturers.

[1] NATURE, **143**, 164 (1939).

Vanadiferous Nodules in Worcester Clay

THE presence of dark nodules in the red Permian marls of South Devon has been recorded[1]. These nodules, which range from pin points to masses of many pounds in weight, attain their maximum development one mile west of Budleigh Salterton. They are surrounded by aureoles of green clay, contain some 14 per cent of vanadium (estimated as V_2O_5) and are radioactive.

We have found analogous structures in the Keuper marls of Gregory's Bank, Worcester. They are mostly very small and, *in section*, consist usually of a black centre ranging from a pin point to 0·8 cm. diameter, the larger ones with a greyish centre and surrounded by a disk of green clay 1–2 cm. in diameter, the perimeter of which is sharply defined against the general background of red clay. The largest nodule found weighed 8 gm. and was egg-shaped. Strata of green clay also occur in the Bank and contain numerous small black inclusions.

The green aureole contains ferrous iron and, as its spectrogram appears identical with that of the adjacent red clay, it seems reasonable to conclude that it has been formed from the latter by reduction or removal of the ferric iron; but it is not clear how this has been effected. The black and grey centres contain some 5·6 and 8·6 per cent respectively of vanadium (calculated as V_2O_5), with traces of titanium; but no nickel could be detected. Any radioactivity must be extremely weak as a photographic plate was not appreciably affected after one month of direct contact.

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July 4.

[1] Carter, *Mineral. Mag.*, 609 (1931).

Co-operative Activation

A CONSIDERABLE number of examples of chemical reactions in organized condensed systems have been observed to occur with activation energies greater than those normally associated with the temperature range at which the reactions occur. These reactions are: (1) the denaturation of proteins, where activation energies of 50–150 k.cal. have been reported[1], (2) $CaCO_3.6H_2O \rightarrow CaCO_3 + 6H_2O$ [2], (3) $K_2SO_4.Cr_2(SO_4)_3.24H_2O \rightarrow K_2SO_4.Cr_2(SO_4)_3.12H_2O + 12H_2O$ [3] and (4) the production of detonation nuclei in solid explosives[4]. On the other hand, in many solid reactions there is no marked deviation from the Polanyi-Wigner equation, the rate in molecules per sq. cm. being given by $\nu.e^{-E/RT}.N$. Thus there is no very large deviation in the case of $Ag_2CO_3 \rightarrow Ag_2O + CO_2$ [5] or $CuSO_4.5H_2O \rightarrow CuSO_4.3H_2O + 2H_2O$ [6], and in exothermic solid reactions; the following figures bear out the same point.

	Temp. ° C.	Rates (mols./cm.² sec.)	
		Calc.	Exp.
Lead azide	270	$1{\cdot}2 \times 10^{13}$	$5{\cdot}3 \times 10^{11}$ [7]
Potassium azide	251	$2{\cdot}0 \times 10^{13}$	$1{\cdot}7 \times 10^{11}$ [8]
Nitrogen iodide	−19	$8{\cdot}5 \times 10^{13}$	$6{\cdot}6 \times 10^{14}$ [9]
Barium azide	115	$1{\cdot}8 \times 10^{17}$	$3{\cdot}1 \times 10^{15}$ [10]

In all these cases, the thermal decomposition is believed to be simple, the unit processes involving at the most the decomposition or the liberation of one or two molecules. For the decomposition of calcium carbonate hexahydrate, the discrepancy is 10^{23} and for chrome alum 10^{11} times. For the denaturation of proteins, the discrepancy is variable and sometimes much larger, It would, therefore, appear that the abnormal cases are those for which a large number of molecules or chemical bonds are involved in the unit reaction.

It is possible to explain the rapid rates of these abnormal processes as due to co-operative activation of a number of points n on the surface within a short time interval τ, the activation energy required at each point being E/n, where E is the measured activation energy. The magnification of the rate which is thereby attained depends, in a complex fashion, on the type of organization involved, on the number of points n which are activated, the number of points m out of which n are chosen, but is independent of the value of τ. For crystalline substances, $\tau = 1/\nu$, where ν is the frequency of lattice vibration ($= 10^{13}$ sec.), but for colloidal substances in aqueous media τ may be so low as 10^{-6} sec.

If we consider the 100 face of a cubic lattice with four adjacent lattice points composing a co-operative group, then it can be shown that the rate of reaction is approximately 10^3 times greater than that for the process of activation of one point with the energy E. For five adjacent lattice points the magnification is approximately 10^4. If we increase either m or n appropriately, then the magnification can be increased to factors of the order of 10^{23}, which was found for the decomposition of calcium carbonate hexahydrate. In order to obtain magnifications of the correct order, it appears to be necessary to increase m, the number of lattice points out of which the n points are chosen. This would mean that the activated points are to be spread over a relatively wide area. Only in the case of detonation nuclei is there any evidence bearing on this point, and this indicates in lead azide and nitrogen iodide that the activated points are spread over an area relatively great compared with the ionic diameter.

For the denaturation of proteins, the process is depicted as the disruption of a small number of bonds within a small time interval of approximately 10^{-6} sec., out of a relatively large number distributed over the surface of the protein molecule, the activation energy for the breaking of each bond being E/n. If in this case m is 100 and n is 4, then the magnification will be 10^8 times. For the decomposition of hydrates, the co-operative activation is regarded as being spread over the surface of the crystal, activation occurring at key points in the lattice, the loss of water from these points which follows the activation being imagined to cause the breakdown of the lattice over a relatively wide area.

An alternative mechanism is one proposed by Eyring and Stearn[1], which ascribes the high rates of reaction to the occurrence of high entropy change on passing from the reactant to the activated complex. On the basis of this hypothesis, in the case of changes in the solid state, an abnormally high energy of activation should be found in those cases where there is a high degree of disorder produced during the reaction, that is, when there is an amorphous product, and a more normal value when the product was crystalline. There is, however, at the present time but little evidence bearing on this aspect of the matter.

W. E. GARNER.

Department of Inorganic and Physical Chemistry,
University, Bristol, 8.
July 7.

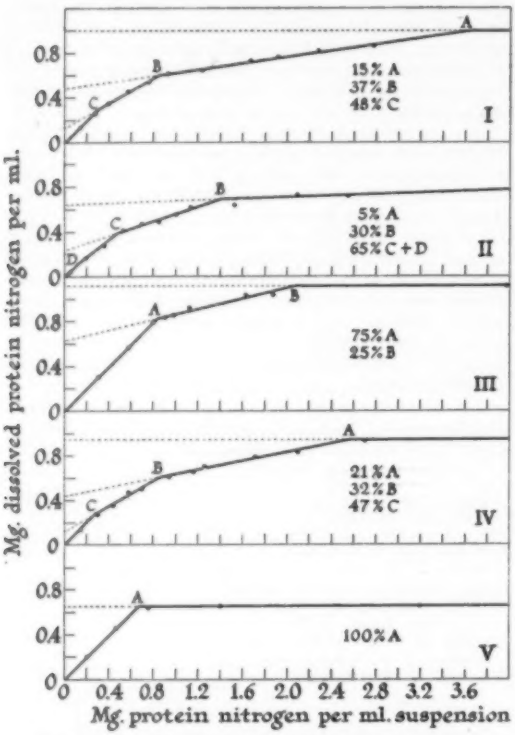
[1] These reactions have been summarized by Eyring and Stearn (*Chem. Rev.*, **24**, 253 (1939)).
[2] Topley and Hume, *Proc. Roy. Soc.*, A, **136**, 413 (1931).
[3] Cooper, J. A. (unpublished).
[4] Garner, W. E., *Trans. Farad. Soc.*, **34**, 985 (1938).
[5] Spencer and Topley, *Trans. Farad. Soc.*, **27**, 94 (1931).
[6] Topley, *Proc. Roy. Soc.*, A, **136**, 413 (1932).
[7] Garner and Gomm, *J. Chem. Soc.*, 2123 (1931).
[8] Garner and Marke, *J. Chem. Soc.*, 657 (1936).
[9] Meldrum, F. R. (unpublished).
[10] Wischin, A. (unpublished).

Existence of Several Active Components in Crude Pepsin Preparations

THE original solubility measurements on crystalline swine pepsin led to the conclusion that the crystals consisted of a single pure protein or several closely related proteins[1]. Since that time, it has become apparent in this and other laboratories[2,5] that pepsins prepared from the various commercial products or from pepsinogen differ in solubility, specific proteolytic activity and stability. Solubility measurements have now been made on various partially purified pepsin preparations in order to determine the cause of these variations.

The results show quite clearly that commercial preparations contain more than one protein possessing peptic activity and that the differences between the various preparations are due to differences in the proportion of the components present. Curve I shows the solubility diagram of the total protein fraction from a commercial 1 : 10,000 Cudahy pepsin preparation. When analysed, as described by Kunitz and Northrop[3], this curve indicates that the preparation is a mixture containing 15 per cent of component *A*, having a solubility of about 0·6 mgm. protein nitrogen per ml. in the

solvent used; 32 per cent of *B* having a solubility close to 0·35 mgm. protein nitrogen per ml., and at least one other component, *C*, having a solubility of about 0·15 mgm. protein nitrogen per ml. The average specific activity[4] of this Cudahy preparation was 0·26 $[P.U.]^{Hb}_{mgm.\ P.N.}$. The experimental methods are not sufficiently precise to allow one to draw positive conclusions with regard to the shape of the curves for the less soluble components.



SOLUBILITY OF CERTAIN AMORPHOUS PEPSIN PREPARATIONS IN 0·5 SATURATED MAGNESIUM SULPHATE—0·05 *M*, *p*H 4·65 ACETATE BUFFER AT 23° C. Solid lines connect determined values; broken lines are extrapolations. ○ indicates clear solutions; ● indicates the presence of one or more solid phases.

Curve II is the solubility diagram of crystalline pepsin prepared from a Parke Davis 1 : 10,000 pepsin. It shows the proportion of the components to be about 5 per cent *A*, 30 per cent *B* and 65 per cent of more insoluble material, part of which is the *C* component having a solubility of about 0·15 mgm. protein nitrogen per ml., the remainder being designated as *D*. The average specific activity of the preparation was 0·23 $[P.U.]^{Hb}_{mgm.\ P.N.}$.

Curve III is the diagram of pepsin prepared from pepsinogen by allowing a solution of pepsinogen to stand 18 hours at *p*H 3·6 and 5° C. Under these conditions, a precipitate forms which was discarded. The soluble fraction contains about 75 per cent *A* which therefore precipitates first in spite of its higher solubility, and 25 per cent of other components, most of which is *B*. The specific activity of this preparation was 0·34 $[P.U.]^{Hb}_{mgm.\ P.N.}$.

If these analyses are correct, then a mixture of one part of pepsin from pepsinogen (Curve III) and three parts of Parke Davis (Curve II) should contain 22 per cent *A* and 30 per cent *B*, and the average specific activity should be 0·26. The solubility curve of this mixture should be very similar to Curve I. Curve IV shows the diagram for such a mixture. The curve indicates 21 per cent *A* and 32 per cent *B*, and the determined specific activity was 0·25, in very good agreement with the expectation.

This result shows that components *A* and *B* form a mixture under these conditions. It cannot be determined with certainty whether *C* and *D* form mixtures or solid solutions since the first part of the curve, where these components appear, is not sufficiently accurate. Either a smooth curve (solid solution) or two straight lines (mixture) fits the results within the experimental error.

Component *A* has been isolated from certain Cudahy preparations of high specific activity. The solubility, as shown in Curve V, is very near that predicted for *A* from Curves I and III. This preparation was strictly homogeneous in the Tiselius electrophoresis cell (we are indebted to Dr. L. G. Longsworth for carrying out this determination) and has the migration velocity and specific activity close to that found by Tiselius *et al.* for the homogeneous protein present in the preparation analysed by them[5]. It has no isoelectric point, as measured by the collodion particle method, if the determinations are made on a fresh solution. On standing, non-protein nitrogen appears in solution and the particles become positive at *p*H 1·5. The *A* pepsin has been crystallized. The crystals are indistinguishable in form from those previously described. The non-protein nitrogen may be removed from the crystals by washing at 10° C. with

$$\left\{\begin{array}{l} M/10 \text{ acetate } p\text{H } 4{\cdot}0 \\ 0{\cdot}6 \text{ saturated magnesium sulphate.} \end{array}\right.$$

The *A* pepsin is much more unstable than *B*, so that 10 hours' heating at 55° C. and *p*H 4·6 completely destroys it and changes the diagram of a Cudahy preparation like that shown in Curve I to one similar to that shown in Curve II.

Solubility diagrams of pepsinogen were found also to indicate several components. One pepsinogen component present in only small quantities yields an unstable pepsin which is nearly twice as active as the pepsin previously obtained.

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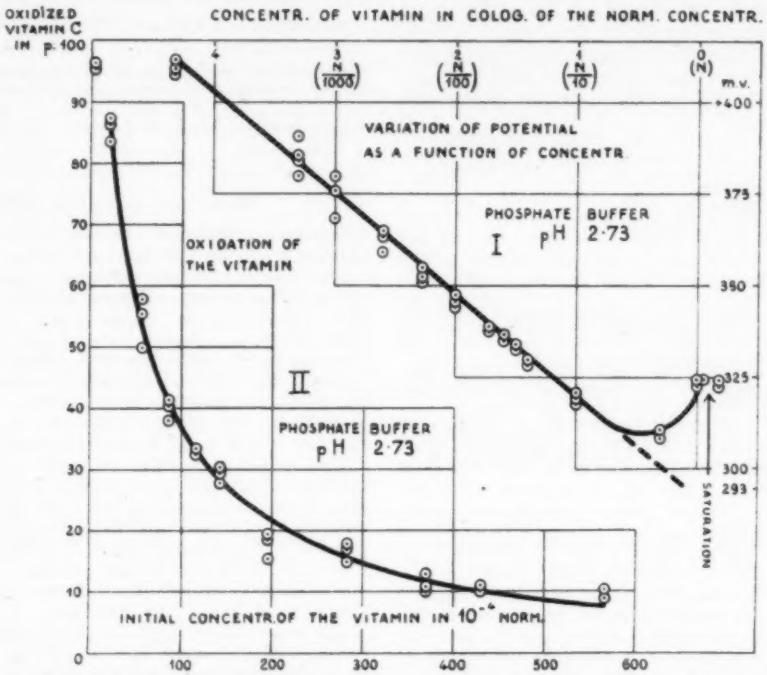
Platinum Potential of Vitamin C Solutions in Contact with Molecular Oxygen

THE platinum potential of solutions containing biological oxidation-reduction agents can be measured when exposed to air by means of a relatively simple technique[1].

We have established between the platinum potential (E_1) and the concentration (C) of fresh solutions of ascorbic acid adjusted to a pH 2·7 (phosphate buffer) at 37°, with a pH of 2·7 (phosphate buffer), gave the following equation:

$$(3)\quad (E_1 - 0{\cdot}3534)\,0{\cdot}42 + \frac{0{\cdot}00047}{0{\cdot}3654 - E_1} = \log \frac{C_{ox.}}{C_{red.}}$$

where $C_{red.}$ is the concentration of intact ascorbic acid, $C_{ox.}$ that of the oxidized vitamin, and E_1 the potential of fresh solutions at a temperature of 20°, as given by equations (1) and (2). The close agree-



CURVE I: SOLID LINE—EQUATION (2); RECTILINEAR PART OF SOLID LINE AND BROKEN LINE—EQUATION (1). VARIATION OF PLATINUM POTENTIAL AS A FUNCTION OF THE CONCENTRATION OF VITAMIN C.

CURVE II: SOLID LINE—EQUATION (3). VARIATION OF QUANTITIES OF OXIDIZED VITAMIN C AS A FUNCTION OF INITIAL CONCENTRATION. ON THE ABSCISSA: BOTTOM: CONCENTRATION OF VITAMIN EXPRESSED IN 10^{-4} NORMAL.

ABOVE: CONCENTRATION OF VITAMIN EXPRESSED IN COLOGARITHMS. ON THE ORDINATE; ON THE LEFT: AMOUNTS OF VITAMIN OXIDIZED, EXPRESSED IN PER CENT OF INITIAL CONCENTRATION. ON RIGHT: VALUES OF PLATINUM POTENTIAL EXPRESSED IN +mV.

(not pH 2·6 as stated before)[2], and exposed to air at 20° the following relations:

$$(1)\quad E_1 = 0{\cdot}2925 \text{ volts} - \frac{RT}{2F} \ln C^{0{\cdot}92} \text{ for concentrations}$$

equal to or less than one tenth normal (17·6 gm. per litre);

$$(2)\quad E_1 = 0{\cdot}309 \text{ volts} - \frac{RT}{2F} \ln \left(\frac{C^{0{\cdot}92}}{(C^{0{\cdot}17} + 0{\cdot}52)^2} \right)$$

for all concentrations.

These equations do not take into account the reversible reaction that seems to be very peculiar in this case. However, they express with a sufficiently accurate approximation the ratio between the concentration of ascorbic acid in solution and the platinum potential of the same (see curve 1).

A study of the oxidation of vitamin in solution kept in contact with air, without stirring, for 24 hours ment of the quantities of oxidized vitamin, both determined experimentally and calculated as a function of E_1 according to equation (3) (see curve II), shows that the values of E_1 were determined accurately.

Another argument in support of the relation set forth, between the dilution and the state of the ascorbic acid molecules, is given by Heintz[3]. This author has studied the infra-red absorption spectra of ascorbic acid present in the solid state and in 0·4 N and 0·1 N solutions (phosphate buffer, pH 2·7). Heintz finds that spectra of ascorbic acid present in the solid state and in the 0·4 N solution are similar; but that a marked change appears in the 0·1 N solution.

We call the potential E_1, as defined by equations (1) and (2), the potential of electronic affinity. This

represents the tendency toward oxidation, that is, the reducing activity of ascorbic acid. The concentration of ascorbic acid checks its reducing activity, which determines the constant of the potential of solutions (*p*H 2·7 at 20°) near 0·4 *N*. In complex media, the vitamin activity can obviously be limited by factors other than its own concentration. In biological media with *r*H clearly above 16·2, the stability of ascorbic acid is due principally to this cause. In fact, it is known that the normal oxidation-reduction potential of ascorbic acid[4] corresponds to a *p*H of 7 with an *r*H of approximately 16·2, while the average value of the blood *r*H is[5] 20·8.

We wish to thank most cordially the Translation Service of the North Carolina State College, Raleigh, N.C., for help in the translation of this article into English.

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[4] Bezssonoff and Woloszyn, *loc. cit.* The *p*H stability of the ascorbic acid solutions was ascertained by means of an antimony electrode system.

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Ozonization of *O*-Xylene and the Structure of the Benzene Ring

A. A. Levine and A. G. Cole[1] ozonized *o*-xylene and were able to isolate diacetyl from the reaction product, while methylglyoxal and glyoxal were isolated in the form of the osazones by means of *p*-nitrophenylhydrazine. This result is of great importance for the theory of the structure of the benzene nucleus. In their paper, Levine and Cole give no evidence about the yield of the substances isolated. Therefore we have reinvestigated this reaction using another analytical method. We have transformed the decomposition products of the ozonides into the corresponding oximes and we have worked out a method for separating the oximes quantitatively.

O-xylene (solidification point − 27°) was ozonized in chloroform solution at − 25°, using oxygen with 2·5 per cent ozone until about the calculated quantity of ozone had been taken up. From the reaction product we isolated:

(1) The oxime of dimethylglyoxal melting at 233–234°, mixed melting point with an authentic sample (m.p. 234–235°) 233·5–234°. (2) The oxime of methylglyoxal melting at 150·5–151·5°, mixed melting point with an authentic sample (m.p. 152·8–153·1°) 152–152·5°. (3) The oxime of glyoxal melting at 170·5–171·5°, mixed melting point with an authentic sample (m.p. 172·5–173°) 171·2–172°.

The yield of oximes amounted to about 20 per cent of the theoretical yield calculated on *o*-xylene. The composition of the mixture was roughly determined as follows: 0·88 mol. of dimethylglyoxime, 2 mol. of methylglyoxime and 3·2 mol. of glyoxime, while the calculated ratio should be 1 : 2 : 3, if the two Kékulé forms each contribute 50 per cent to the structure of *o*-xylene. It will be necessary to improve our analytical method before we can give the exact value for the molecular ratio of the oximes.

The work of two independent groups of workers now affords chemical evidence for the occurrence in *o*-xylene of two resonating Kékulé structures. The investigation is being continued from the quantitative point of view; full details will be published in the *Receuil des Travaux Chimiques des Pays-Bas*.

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Photo-oxidation of Pyrrhole

FRESHLY redistilled pyrrole dissolved in water, alcohol or acetone and mixed with $0·5 \times 10^{-4}$ *M* methylene blue rapidly takes up oxygen in the light but not in the dark. Pyrrole alone is not oxidized. The rate of oxygen uptake is a linear function of light intensity. Eosin, but not fluorescein, can be used instead of methylene blue. Tests with standard optical filters showed the effective wave-lengths to be within the range of 5200–5800 A. On the basis of 5500 A., the energy necessary to institute the reaction is $3·4 \times 10^{-12}$ ergs/molecule.

Two atoms of oxygen are taken up per molecule pyrrole. There was no decarboxylation or deamination. The methylene blue was removed by a minimal amount of charcoal and the solution evaporated to dryness. The residue was extracted with acetone which on evaporation left crystals. These were recrystallized several times from boiling benzene. The analysis was C, 49·1 per cent, H, 5·3 per cent, N, 14·1 per cent; m.p., 102·5°; yield, 58 per cent. Mixed melting point determinations showed that the substance was not succinimide. On alkaline hydrolysis, it yielded 14 per cent ammonia nitrogen and 72 per cent succinic acid.

n-methyl and *n*-ethyl pyrrole are also oxidized under the same conditions, but only one atom of oxygen is taken up per molecule.

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Crotoxin

IN May of last year[1] we announced that we had been able to purify and crystallize the chief toxic principle of rattlesnake venom, which we called crotoxin. Crotoxin contains the whole neurotoxic and hæmolytic activity of the crude venom; but both have a 25 per cent greater activity than the crude.

The following are the main points of evidence that crotoxin is a pure and homogeneous substance:

(1) The analytical data[2] obtained from different samples of crotoxin at different times are the same (C: 50·77 per cent and 50·56 per cent; H: 6·41 per

cent and 6·47 per cent; N: 15·86 per cent and 15·90 per cent; S: 3·96 per cent and 4·03 per cent).

(2) Five recrystallizations of crotoxin did not alter its neurotoxic and hæmolytic activity.

(3) The solubility curve of crotoxin at different ammonium sulphate concentrations[2] shows the straight line typical of pure substances[3].

(4) Gralèn and The Svedberg[4] were able to show that crystalline crotoxin in the ultracentrifuge "behaved in sedimentation and diffusion as a homogeneous substance".

Recently Gosh and De[5] reported one experiment: a solution of 100 mgm. of crude rattlesnake venom secrete was saturated with sodium chloride. After standing for one night at 6° a precipitate was obtained which contained 8–10 per cent of the original hæmolytic and 2–2·5 per cent of the neurotoxic activity. From this difference of the ratio of neurotoxic to hæmolytic activity in such a precipitate, the Indian authors conclude that our crystalline crotoxin cannot be a homogeneous substance.

We see no reason to discuss such experiments executed with the crude venom secrete since we have already shown how to crystallize the active principle of rattlesnake venom, easily and in good yield.

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Cytology of the Common Male Fern in Britain

IN a paper which has just come to hand by Döpp[1], cytological observations of some importance are given with regard to the genus Dryopteris (= Lastrea = Nephrodium) in Europe. In particular, and among other things, apogamy is reported in "*D. paleacea*" from four localities in Germany and Switzerland and the chromosome number in one of these plants is given as "*c.* 130" in contrast to the sporophytic number for normal *D. Filix-mas* which was previously found by the same author to be *c.* 160[2].

These observations are so closely cognate to a large body of work which has been in progress for some years on the British fern flora, that it may perhaps avoid a profitless duplication of effort, if the main facts which I have obtained for *D. Filix-mas* (*sensu lata*) in Britain are summarized in advance of the main paper.

So long ago as 1855[3], a very shrewd field collector, Wollaston, expressed the view that at least two of the varieties described for the male fern in Great Britain, namely, the varieties *Borreri* and *abbreviata* of Newman, were worthy of specific rank. Newman's varietal names were regarded as synonymous with the varieties *paleacea* and *pumila* of Moore; but to emphasize the idea of specific distinctness Wollaston introduced two new terms, namely, *pseudo-mas* and *propinqua*[4]. These have never penetrated deeply into purely botanical literature, but they have been (and still are) widely used by amateurs and fern collectors in Great Britain. They are a commonplace of English pteridological handbooks of the older school (for example, Druery[5]) and are represented in the *L. pseudo-mas* var. *polydactyla* Wills and Dadds quoted by Döpp. By modern rules of nomenclature both *pseudo-mas* and *propinqua* are illegitimate, since priority rests with the names of Newman. In view of their historical importance, however, it is necessary that their meaning should be understood.

My own work on this subject began in 1936 with the discovery of an apogamous plant from central Ireland with *c.* 120 chromosomes. This plant was identified by Mr. Alston of the British Museum as *D. Filix-mas* var. *Borreri* Newm. The cytological findings were at that time so unexpected that field investigations were at once undertaken in order to elucidate them. In the three years which have elapsed, cytological observations have been made on nearly one hundred plants from more than twenty localities in England, Scotland, Ireland and Wales. In carrying out this field exploration, Wollaston's classification has been found to be of the greatest service and has indeed been the only one which could immediately be applied to the problem. The results are as follows:

(1) Wollaston's *L. propinqua* (= *abbreviata* Newm). has been obtained from England, Ireland and Wales. It reproduces sexually and has a gametic chromosome number of 40–41. This number I regard as haploid and the sporophytic number (*c.* 80) of this form as diploid.

(2) Wollaston's *L. Filix-mas* proper, the commonest hedgerow type in England, also reproduces sexually, but has a sporophytic chromosome number of *c.* 160 (as previously reported by Döpp)[2]. This number I regard as tetraploid; but the meiotic behaviour is not that of a recent auto-tetraploid.

(3) Wollaston's *L. pseudo-mas* (= *Borreri* Newm. = *paleacea* Moore) appears to be exclusively apogamous and therefore contains a potentially infinite variety of true-breeding strains. My own first plant with *c.* 120 chromosomes and presumably also those of Döpp ("*c.* 130") I interpret as triploids. Local populations of diploids, with *c.* 80 chromosomes and tetraploids with *c.* 160, all apogamous and with the morphology of *pseudo-mas*, have since been met with and there may be still higher polyploids to be discovered.

There is strong evidence to suggest that all three of Wollaston's types can hybridize; but I do not consider this to invalidate the conclusion that they could and should be regarded as three distinct species. I therefore agree with Döpp's desire to accord specific rank to *D. paleacea* though this is clearly only a part of a larger problem.

While further discussion must be left to the fuller statement, a word of appreciation may perhaps be allowed here for the abilities of a man like Wollaston who, with only the morphology to guide him, should have correctly divined these relationships, against the views of contemporary botanists.

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[4] Wollaston, G. B., *The Phytologist*, **6**, 415 (1862).
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Role of the Renal Innervation in Kidney Function

OBSERVATIONS have been made on the role of the renal innervation in kidney function. A dog's kidney was transplanted to the inguinal region by end-to-end anastomosis of the renal vessels to the femoral; the bladder and distal ureteral orifices were exteriorized. Convalescence was uneventful and both kidneys gave every tested physiological evidence of normal function. During antidiuretic, that is, normal, urine flows, the rate of urine flow and of glomerular filtration is greater in the transplanted kidney than in the untransplanted kidney of the same animal. Following administration of a large quantity of water or of a small dose of adrenalin, the above differences become strikingly reversed; this strongly suggests that the transplanted kidney has continued to be effectively denervated. It was demonstrated that phenol red, water and chloride secretion are practically identical in both kidneys *per unit volume of glomerular filtrate*. Cogent evidence is presented indicating that adrenalin normally acts indirectly on the vas efferens of the glomerular vascular tufts, that is, only by way of the renal nerve supply, and that "pituitrin" acts directly on the tubules. The work will shortly be published in full.

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Points from Foregoing Letters

Absorption experiments have been made in lead and air of the primary radiation responsible for the heavy particle component of the cosmic rays. It is shown by W. Heitler, C. F. Powell and G. E. F. Fertel that this primary radiation consists neither of electrons nor mesotrons, and it is suggested that the best working hypothesis is provided by the assumption that the heavy particles are produced by neutrons. An atomic 'explosion' has been observed in which one of the fragments consists of a highly charged nucleus with a very great specific ionization and showing marked effects due to 'capture and loss'.

A. and E. Vassy infer from computations of the mean temperature of atmospheric ozone, which agree with radio-sounding measurements, that in arctic countries the stratosphere is very hot in summer and very cold in winter; the higher the altitude, the greater the difference between the extreme temperatures.

M. E. J. Gheury de Bray states that the velocities of recession of extra-galactic nebulæ are so large as to throw doubt on their reality. An alternative explanation of the red-shift is proposed, based on the fact, shown by every observation made during the last half century (seven determinations), that the velocity of light decreases with time.

C. H. Douglas Clark has extended his work on the relation between dissociation energy and internuclear distance of carbon-carbon linkages to di-atoms of the HH, KH and KK periods in ground states. It is found that, with the aid of a relation due to Sutherland, this leads to new functions involving bond constant and internuclear distance, having characteristic values in given periods for di-atoms of similar electronic configuration. It appears that extension to excited states is possible.

G. W. Scott Blair and Miss F. M. V. Coppen have shown that the compression moduli of nearly elastic rubber cylinders can be subjectively distinguished with three times the accuracy obtaining in the case of the viscosity of truly fluid bitumens, and have found certain significant differences between subjects having different types of training.

Minute nodules containing vanadium have been found by J. Newton Friend and R. H. Vallance in the Keuper marls of Worcester. They are surrounded by a greenish aureole in the red marl and, in composition, resemble the larger nodules found in the red Permian marls of Budleigh Salterton.

In reactions in organized condensed systems, the rate of reaction is given by the Polanyi-Wigner equation when but few molecules or chemical bonds are involved in the unit process. In order to account for the high rates of reaction met with in a number of complex processes, comparative activation is suggested by W. E. Garner as a possible mechanism.

V. Desreux and R. M. Herriott have analysed several commercial pepsin preparations by the solubility curve method. Measurements showed that at least three or four active proteins are present which differ from each other in solubility, stability and specific activity. One of the active components was isolated in solubility pure form and crystallized. The proportion of the components varied in the different commercial preparations.

N. Bezssonoff and Mme. Woloszyn give the equation of platinum potential as a function of concentration of ascorbic acid in fresh solution in contact with oxygen. The potential becomes practically stable when the reducing activity of the vitamin is checked by its own concentration. Inhibition of this activity by factors other than concentration explains the presence of intact ascorbic acid in biological media where the oxidation-reduction level is very high.

From the reaction product obtained by the ozonization of *o*-xylene J. P. Wibaut and P. W. Haayman isolated dimethylglyoxime, methylglyoxime and glyoxime in a molecular ratio of about 0·88 : 2 : 3·2 and a total yield of about 20 per cent calculated on *o*-xylene. This result, which corroborates the qualitative results of A. A. Levine and A. G. Cole, gives evidence for the occurrence of two resonating Kékulé structures in *o*-xylene.

According to F. Bernheim and J. E. Morgan pyrrole is rapidly oxidized in the presence of methylene blue and light. A substance of unknown structure is formed which on hydrolysis yields succinic acid and ammonia.

Cytological evidence is quoted by I. Manton in reply to a paper by Döpp to show that the common male fern (*Dryopteris Filix-mas*) in Britain really consists of three distinct species, one of which is sexual and diploid, another is sexual and tetraploid, while the third is apogamous and contains a variety of polyploid forms.

RESEARCH ITEMS

Aboriginal Races of India

B. S. GUHA in a racial analysis of the aboriginal peoples of India (*Science and Culture*, **4**, 17, June, 1939) points out that of the inhabitants of all India, 22½ millions, in round numbers, are still in a primitive state, living by hunting, fishing and on forest produce, and forming 6½ per cent of the entire population, but that if to these are added the fifty millions and more of the so-called "exterior castes", who are mostly detribalized primitive folk in process of entering the Hindu social system, the proportion becomes twice or even thrice this figure. Regionally these tribes are grouped into three separate zones. (1) A northern and north-eastern division of about three million people, scattered over a very large area of the sub-Himalayan region and the mountainous territory of Assam and north-eastern India, and merging into those of Burma and Yunnan. (2) A central division occupying small hills and plateaux traversing the entire breadth of the country from the Gulf of Cambay to the Orissan coasts, and comprising the Bhil, Gond, Kol, Oraon, Munda-Santal, etc. (3) The southern division, the smallest, containing little more than a hundred thousand people, spread over the hills of southern India, especially the extreme south-western strip. There is a rough parallel between the geographical distribution and the linguistic affinities of these peoples. Among the northern and north-eastern group the languages are of the Tibeto-Chinese family, with certain small exceptions. In the central division the languages spoken belong chiefly to the Munda branch of the Austric family, though certain peoples have adopted Aryan and Dravidian tongues. The southern group now speak entirely Dravidian languages in corrupt forms; and in the absence of a linguistic survey there is no means of knowing whether any traces of their original languages, Austric or other, survive. The same parallelism, however, does not exist in physical features, which show strains of Negrito, Proto-Australoid, a brachycephalic element with two subdivisions, one being more primitive than the other, and fourthly a medium-statured dolichocephalic element chiefly distributed in the Assam hills and mixed no doubt with short-statured Palae-Mongols.

Negro Education in the United States

AN analysis of the statistics of negro education in the United States of America for the years 1933–4 and 1935–6 by David T. Brose and Ambrose Caliver (U.S. Department of the Interior, *Bull.* 1938, No. 13) collects evidence of progress in dealing with one of the vital population problems of the country. Despite the depression, remarkable advance was made between 1933 and 1936, as also in the two preceding decades, more especially in the number of public high schools and their enrolment. In 1915, 58 per cent only of the negro children were enrolled in school; in 1930, the percentage had risen to 84, and in 1936 it is probably greater. This increase represents, among other things, a growing appreciation by the negroes of the value of education in the solution of their problems. It is now recognized among them that "the improvement of the rural and urban masses in health, honesty, labour and thrift is directly dependent on the public elementary school". Among definite results illiteracy has been reduced from 30 per cent in 1910 to 16 per cent in 1930. The number of elementary and secondary school enrolments in 1935–6 totalled 2,438,981, being 24·2 per cent of the total negro population of 18 States. This is a slight decrease from 24·5 per cent in 1931–2, but represents a slight increase from 81 to 82·8 per cent of the negro child population between the ages of five and seventeen years. The fluctuation between 1917–1936, probably due to economic causes, shows a definite upward trend for six years following on the Great War, a recession in 1924–28, followed by a sharp rise in the boom years 1929 and 1930, with a continued high percentage in the years of depression, due in part to lack of employment, in part to assistance from public funds. The number of schools in 1935–6 is public elementary, 24,405, public high schools, 2,305, the latter a great development from 64 in 1915–16.

Human Schistosomiasis and its Intermediate Hosts

DR. ALAN MOZLEY (*Trans. Roy. Soc. Edin.*, **59**, No. 26; 1939) has described twenty-six species of freshwater molluscs from Zanzibar, Pemba and Tanganyika Territory as a preliminary to the study of the species concerned with the transmission of the parasite causing schistosomiasis in man. Although the infection is slight when compared with conditions in Egypt, yet its effects are considerable, and might, in the opinion of the author, be brought under control by extermination of the molluscs over infected areas. In Zanzibar and Pemba, 10–70 per cent of the natives are infected with *Schistosoma hæmatobium*, while in Tanganyika *S. mansoni* is the prevalent parasite. Mozley suspects that *Physopsis globosa* (Morelet) transmits *S. hæmatobium*, and was able to prove experimentally that *Biomphalaria pfeifferi* carries *S. mansoni*. He describes the general ecological conditions governing the life and distribution of freshwater molluscs in the area, noting that as a result of these conditions the distribution is strictly limited to a small proportion of the ponds, lakes and streams. He discusses control methods involving destruction of the molluscan intermediate host, recommends drainage, flushing and chemical means, but considers that plant poisons and biological control methods are not yet fully worked out. He is optimistic, however, that the disease could be stamped out in Zanzibar within five years, and over the whole area in a somewhat longer period.

Pleiotropic Gene-effects in the Rat

H. Grüneberg, 1938, and H. B. Fell and H. Grüneberg (*Proc. Roy. Soc.*, B, **125**, 123–144, and **127**, 257–277; 1939) have investigated the effects of a gene in the rat which, in the homozygous condition, causes the death of the individual. About the time of birth the rib cartilages become abnormal (formation of thick capsules around the cartilage cells, and a very active cell proliferation). These abnormalities give rise to secondary symptoms the intensity of which

differs in different individuals. The abnormal thickening of the rib cartilages leads to a distortion of the thoracic basket and internal organs. Respiratory rib movements become impossible. As a consequence, emphysema of the lungs and sometimes compensating collapse in some regions of the lungs develops. Heart trouble occurs regularly as a consequence of the emphysema. Death occurs suddenly or slowly, depending on the type of cardiac failure which is induced, and not infrequently due to hæmorrhages into the lungs. Other deaths are caused by an inability to clean dirt from the nose which is normally brought about by sneezing. The presence of dirt prevents effective suckling, and starvation results. By reciprocal transplantation and tissue culture methods, it is shown that the abnormality of the cartilage is self-differentiating in post-embryonic life.

Vegetative Propagation of a Fern

THE number of vascular cryptogams which can be propagated vegetatively is remarkably small, but a recent short paper by E. E. Kemp (*Gard. Chron.*, July 15) describes an unusual method of regeneration from isolated, swollen leaf-bases of the fern *Marattia fraxinea*. These organs, which persist on the plant after the leaves have fallen, were placed on the surface of a coco-nut fibre rooting medium in a propagating case with a bottom temperature of 80° F. Buds then formed on the abaxial surface, either upon the leaf-base itself, or upon one of the stipules. When the buds had produced several roots from the base, they were removed and grown separately, still in the propagating case. The method offers one of the most economical means of vegetative propagation, since the old leaf-base will continue to produce additional buds until its stores of food become exhausted.

Smut Fungi of India

A PAPER by B. B. Mundkur (*Trans. Brit. Mycol. Soc.*, **23**, Pt. 1, 86-121, May 1939) gives the results of a critical re-investigation of forty-four collections of Indian smut fungi in the Herbarium Cryptogamæ Indiæ Orientalis of the Imperial Agricultural Research Institute at New Delhi. Only twenty-five species are represented in the collections, but seven of these are now described for the first time, and five are new taxonomic combinations. The new species are *Ustilago polytocæ*, *U. barberi*, *Sorosporium penniseti*, *S. azmatii*, *Sphacelotheca dinebræ*, *S. sahayai* and *Tilletia ajrekari*. The collections are not exhaustive, for 110 species of smut fungi are recorded for India. These new species are, however, parasitic upon plants which are peculiar to that region, and it is gratifying to see such progress in their critical determination as is revealed by the paper under review.

Solubility of Cements

A PUBLICATION by the Department of Scientific and Industrial Research, "The Solubility of Cements", (Building Research Technical Paper No. 26. London: H.M. Stationery Office, 1939, 6*d*. net), describes some investigations made for the Joint Sub-Committee on Special Cements of the Institution of Civil Engineers and the British Committee on Large Dams. The report deals with the deterioration of cements when exposed to certain types of waters, especially soft waters common in many mountain areas, and tests made with five types of cement show that the extraction tests on ground set cements, developed originally in Sweden, afford a simple measure of their susceptibilities to attack adequate for practical purposes.

Physics Research at Harvard

VOL. 4 of Series 2 of *Contributions from the Physical Laboratories of Harvard University* for the year 1937 includes fifty-four papers which have appeared in the *Physical Review* and other scientific periodicals up to March 1938. About 18 per cent of them are from the high pressure laboratory of Prof. Bridgman in which the physical properties of substances at pressures of the order of 45,000 atmospheres are being investigated; about 11 per cent from that of Prof. Van Vleck which deal with magnetic susceptibilities and dielectric constants; 9 per cent from that of Prof. Pierce which deal with vibrations and supersonics, and others from the laboratories of Profs. Bainbridge, Oldenberg and Street dealing with mass spectra, molecular spectra, radioactivity and cosmic rays respectively. In addition, there are papers by other members of the staff and by seven fellows either of Harvard or national research fellows, and Dr. E. H. Hall has two papers on the four transverse magnetic effects which he has measured with greater accuracy than has been possible hitherto. With the staff available at Harvard a wide field of research can be covered, and the amount of work done is impressive.

The Absolute Ampere

SINCE the decision of the International Committee on Weights and Measures in 1927 that the material standards for all electrical units should approximate as closely as possible to the absolute theoretical units, the standardizing laboratories of the world have been determining with the precision now available the values of their concrete standards in terms of the absolute units. The International Ampere was defined at the London International Conference in 1908 as depositing 0·001118 grams of silver per second. The precise measurement of current depends in practice on the use of a potentiometer, a standard ohm and a standard cell, which each laboratory possesses. The comparison between the ampere so measured and the absolute ampere as measured by some form of current balance has been made in several of the most important national laboratories. That made recently at the Bureau of Standards by H. L. and R. W. Curtis and C. L. Critchfield is described in Research Paper R.P. 1200 of the Bureau. By means of an improved form of Rayleigh balance, they find that the Bureau International Ampere is 0·99986 absolute amperes, which agrees exactly with the result obtained at the National Physical Laboratory three years ago for the N.P.L. International Ampere.

Balloon Experiments in High Latitudes

H. Carmichael and E. G. Dymond (*Proc. Roy. Soc.*, A, **171**, 321; 1939) have now published the results of their balloon experiments made near the geomagnetic pole in North-West Greenland (see NATURE, **141**, 910; 1938). The primary object of the experiments was the determination of cosmic ray intensities at high altitude, and two forms of apparatus were used: a coincidence counter set which transmitted wireless signals during its flight and which did not need to be recovered, and a photographic recording

version of the 'ticking' quartz fibre electroscope. The balloon technique was based on that of Regener, and several flights were made with both sorts of apparatus up to about 20 km. The results, when compared with those of other workers at lower latitudes, indicate that there is practically no increase in the cosmic radiation incident at the top of the atmosphere between geomagnetic latitude 50° and the geomagnetic pole. Since cosmic rays of low energy, between $3 \cdot 10^9$ and $2 \cdot 10^9$ ev., would be admitted in increasing numbers by the earth's magnetic field in this region, it must be concluded that no rays of low energy reach the earth from outer space. They may, perhaps, be cut off by some external magnetic field such as that of the sun. The expedition obtained a good deal of aerological data from the flights made by the apparatus and incidentally with pilot balloons. The stratosphere wind speeds found on this summer expedition were very low and the apparatus often descended near its starting point. The tropospheric wind speeds showed a well-defined maximum at about 9 km., probably just below the tropopause. A meteorograph flight showed a well-marked tropopause at 11·2 km. and an unusual rise of temperature in the stratosphere.

Reflectivities in the Ultra-Violet

G. B. SABINE (*Phys. Rev.*, **55**, 1064; 1939) has made an investigation of the reflecting power of a number of evaporated metal films in the wave-length region from the visible to λ 450 A. Aluminium has a high reflecting power down to λ 2000 A., which falls off steadily at shorter wave-lengths. Below 1200 A. it is exceeded as a reflector by several metals. Silver, as is well known, reflects very little in the neighbourhood of 3000 A. Below this its reflectivity rises again. Its value in the region of 1000 A. is about 10 per cent, and is higher than that of most metals. Platinum is the best mirror found for wave-lengths less than 1200 A., and its reflectivity from 1200 A. to 400 A. varies from about 15 per cent to about 8 per cent. Data are also given in the form of reflectivity curves for Pb, Mn, Be, Fe, Pd, Ni, Ti, Au, Cd, Zn, Te, Mo, Zr, Bi, Mg, Cr, Sb, Cu.

General Analysis

THE striking analogies between apparently unrelated branches of mathematics led the late E. H. Moore to assert that there must be a general theory, which he called general analysis, underlying these particular theories and unifying them. His first attempt to develop such a theory was of a postulational nature. This is fully accessible in his published papers. His second attempt, of a more constructive type, occupied him from 1915 until his death in 1932; but it has hitherto been described only in fragmentary form and in scattered papers. The American Philosophical Society has now undertaken to present a full account of the theory. The first part appeared in 1935, and dealt with the algebra of matrices. The second part, the fundamental notions of general analysis, appeared this year. There are two more parts still to come, generalized Fourier series and modular spaces, and the characteristic value problem in general analysis. The work has been carried out by R. W. Barnard, who has revised Moore's notes and provided an introduction to each chapter, so as to render as easy as possible the comprehension of what must, in view of its generality, necessarily be a highly abstract theory.

Fission of Rotating Bodies

R. A. LYTTLETON has published a paper (*Mon. Not. Roy. Astro. Soc.*, **99**, 7; May 1939) replying to K. E. Edgeworth's criticism of some of his views (see NATURE, July 8, p. 81). Lyttleton points out several inaccuracies in certain dynamical principles in Edgeworth's paper, and a few of these are worthy of notice. Edgeworth believes that in the rapid and continuous transition of a satellite from a circular to a parabolic orbit the kinetic energy at a selected point on the latter orbit must be considerably greater than that possessed in its original circular orbit. Lyttleton shows that this is incorrect; the energy of escape varies inversely as the distance apart of the components and the kinetic energy in circular motion is half the kinetic energy in parabolic motion at the same distance. Using the figures which were given in Edgeworth's paper, the amount of energy possessed by the satellite in the circular orbit is about four fifths the energy that it has in the parabolic orbit—not a great difference and considerably less than Edgeworth estimated. In addition, it is shown that the direction of the force required to produce parabolic velocity should be nearly perpendicular to the direction drawn by Edgeworth in his paper. This force is actually radial in direction and is due to pressure, and no mention of this pressure is made by Edgeworth. Lyttleton next shows that the process of fission described by Edgeworth is open to serious doubt. When Jeans suggested the mechanism of the initial development of the pear-shaped figure in 1928, it was not then generally recognized that the pear-shaped figure is ordinarily unstable, and in point of fact the pear-shaped series of figures does not come into existence. Irrespective of this, the details of the process of fission developed by Edgeworth are open to doubt. In particular, why should the spiral arm just extend to Roche's limit, and why should the velocity be such that the tip of the arm does not come within the limit again and suffer disruption? These and other objections seem to impair very seriously the validity of Edgeworth's criticism of certain views advocated by Lyttleton.

Twelve New Southern Variables

MR. J. B. G. TURNER has given a brief description of his discovery of twelve southern variables with the Victoria 24-inch telescope, Cape of Good Hope (*Mon. Not. Roy. Astro. Soc.*, **99**, 7; May 1939). The plates taken for parallax determination consist of upwards of twenty-five, divided nearly equally among five epochs of observation, an epoch representing at least four weeks. A plate of good definition was selected as standard, and the remaining plates were in turn superposed upon it so that the star images of the upper plate were brought into proximity to, but not exact coincidence with, the corresponding images of the standard plate. The resulting pairs of images were then examined for evidence of variation. When a star was suspected of variability, comparison stars were selected as close to it as possible, and when their magnitudes were established, the magnitude of the variable was determined from a comparison of the size and density of its image on each plate with those of the comparison stars on the same plate. A description is given of the method finally adopted for the determination of the magnitudes of the comparison stars, which proved very satisfactory.

RECENT ARCHÆOLOGICAL EXCAVATIONS IN EGYPT

THE Merimda Civilization. Results of importance for their bearing on stratigraphical relations and development in culture were obtained in the excavations of the Academy of Sciences on the prehistoric site of Merimda-Beni Salama, west of the Nile Delta, which lasted from January 25 until April 4, 1939. In this season—the seventh devoted to this site—it has been demonstrated that of the various levels each corresponds to a different stage of development, contrary to the earlier conclusion that the Merimda civilization was uniform throughout. Although, it is true, the population did not change, and the mode of life throughout was the same—the practice of agriculture, combined with stock-breeding and hunting—while their weapons and tools were similar, and their burial customs identical, yet it is now possible to trace development.

Three levels of occupation can be distinguished. The first is a wide stretch of sand, yellowish in colour, on which the inhabitants lived in lightly constructed huts, too widely spaced to prevent the invasion of the sand, in which the hearths are visible in black, while the interments are shown by greyish tints. The second level is of a light grey colour, showing a series of superimposed surfaces, hardened by occupation. The constructions were closer together, and of a more solid character. The third layer is of a deep blackish colour, consisting in the main of the debris of human habitation, in which the proportion of sand is very much less than in the earlier levels. The settlement evidently was a much closer agglomeration of structures, oval in shape and constructed of lumps of clay, which make their appearance for the first time together with large baskets for cereals. These baskets were buried in the earth, and are replaced later by large pottery jars. The evidence shows a development from a scattered occupation to a compact town, traversed by streets.

It has now been established that numerous types of pottery found in the primitive settlement are perpetuated throughout the whole duration of occupation, but that others disappear in the course of development. Such, for example, is the fate of fine basins of a hard clayey material, with a brilliant red polish on the exterior, except for an unpolished horizontal band engraved with a palm-leaf motif. This is found more rarely and of inferior quality in the second layer, and disappears, and with it the palm-leaf motif, in the third. Next season's work will be devoted to working out further evidence of development on these lines.

Saqqara. During the last two or three seasons, the excavations by the Antiquities Department of the Step Pyramid at Saqqara have been intermitted in the interests of clearance and preservation. In the past season, M. Lauer has been engaged in clearing the great court, measuring 180 m. by 100 m., at the south of the pyramid. The clearance resulted in the discovery of fasciculated column drums of the colonnade in process of being restored, portions of boundary stones inscribed with the names of Zoser and the princesses Hetep-her-nebti and Int-ka-s, and a small fragment of the statue of Zoser with the titles of Im-hotep belonging to the statue found twelve years ago.

Among other finds were three little granite statuettes of the Fifth Dynasty, which had been stolen by robbers but abandoned. Two of them represent the same person standing. They bear traces of colour on the head, the eyebrows, the eyes, and the nails, the granite representing the skin. The clothing was also painted. The third statuette of black granite also bears traces of colour, and is inscribed with the name of Her-en-kaw, director of the scribes of the textile fabrics. A head of a woman in stuccoed and painted wood found near by, which seems to date from the New Kingdom, shows a pair of earrings which are painted black.

Before the close of the season, the clearance was completed of the south side of the Pyramid of Unas and of the contour of his funerary temple. Evidence was then brought to light that Unas, in order to build his own pyramid, had completely destroyed the funerary monument of his predecessor Dadkare. This action, taken in conjunction with the evidence of certain inscribed material, found in the course of the work, raises the important historical point as to the identity of the ruler responsible for the change of dynasty usually attributed to Teti. To this question no answer can yet be given.

Tuna el Gebal (Hermopolis West). Excavations on this site by the Fouad I University, which last season had been occupied with material of the Ptolemaic period, were again pushed forward in Gallery *C*, and by the end of the season had reached the period of Psammetichus and Amasis. On clearing the gallery, an interior room cut below it appeared. Here, in a further chamber, a remarkable discovery was that of a sarcophagus. Previous evidence suggested that these galleries had been reserved for the mummies of ibises and baboons; but the sarcophagus proved to be that of a prince and chief priest of Hermopolis. The chamber was filled with canopic jars of alabaster, covered with inscriptions, and placed in pairs on either side of the sarcophagus. Their covers were carefully sculptured with the heads of the four "Sons of Horus". At the right of the sarcophagus at the foot were 400 blue faience statuettes (ushabtis) inscribed with the name of the high-priest Ankh-hor; while on the east side were several blue faience vases containing unguents, fruits, and gilded leaves. The sarcophagus contained a mummiform coffin of wood. The mummy wore a mask of silver and a band of gilt leather on the chest. On both sides of the body were two sheets of gilt bronze bearing in relief figures of the four "Sons of Horus". The mummy lay with head to west.

Another corridor filled with jars which, apparently, had not been reached by robbers, yielded 125 statuettes of Osiris in bronze, statuettes of Isis, and of the bull, while among the finest pieces was a prince of Hermopolis standing between the goddesses Isis and Nephthys with Horus in front of him on a lotus column, flanked by the two uraei of Upper and Lower Egypt. This ensemble is before an Ibis seated on a stand, sculptured and set with stones of many colours imitating lotus flowers.

EARTHQUAKE INSURANCE

By E. TILLOTSON

GENERALLY speaking, earthquake insurance is still only undertaken in very few cases and usually with reluctance by underwriters. This is understandable in that exact statistical evidence only exists in the majority of cases over a period of 40 ± 10 years, which is insufficient to make it possible to judge when another shock is likely to take place in any particular locality. Moreover, in the present state of knowledge, earthquakes cannot be predicted exactly by any other means. It is, however, possible to indicate which areas are more likely to experience earthquake shocks than others, and it should therefore be possible to initiate some sort of insurance against these natural calamities.

Further difficulties are, first, to envisage how much damage is likely to be done by a shock, and secondly, to build up sufficient reserves of capital to cover the losses. Given sufficient interest on the part of property owners in this type of insurance, mutual assistance by companies and perhaps initially Government aid to companies undertaking earthquake insurance, the question of reserves of capital could be solved and the companies could then proceed to formulate premium rates. One may suppose that these will be governed in any particular case by several factors such as expectancy of occurrence of shocks, type of building, amount of coverage, and an additional sum for expenses, profit and reserves.

The expectancy of occurrence of shocks varies according to the locality and can at best only be evaluated roughly. As example, it appears that in Japan there may be a severe shock every three or four years, whilst in the United States it has been estimated that there is a strong shock approximately every twenty-five years with a tendency for it to occur in the west rather than in the east. In Great Britain, scarcely any damage is done by earthquakes at all.

Buildings vary greatly from the steel-framed reinforced concrete buildings of low altitude such as those designed by Dr. Tachu Naito, of Tokyo, which suffer very little in any earthquake, to concrete block buildings and the native huts of tropical countries, which are often completely razed. Between these extremes, buildings offer various degrees of resistance to earthquake shocks, and it would not be difficult in the light of knowledge gained in previous shocks to classify buildings according to the extent to which they would be likely to be damaged should an earthquake of known intensity occur.

The type of ground on which a building rests also has an important effect on its resistance to earthquakes. Structures on unconsolidated sand or swamp suffer much more severely than those of similar design built on solid ground or rock. Also buildings over old faults are particularly liable to damage, as the faults nearly always renew their movement during an earthquake. For these reasons the advice of a geologist would be very valuable to any company undertaking earthquake insurance risks.

It is usual in all cases of insurance to calculate annual premiums from the formula

$$P = Cp,$$

where P is the annual premium, C the amount of covering and p the probability of occurrence of the disaster. It has been shown by Marchant that this formula may lead to

$$P = \int_A^U y\,x\,dx + U\int_U^V y\,dx,$$

where y is the probability factor that the sum of money involved in the accident be just x, V the total value of the goods and buildings involved in a possible accident, A the value of the goods not insured, and U the upper limit of payments guaranteed by the assurer. The difficulty in the case of insurance against earthquake hazards is to determine the form of y. Working purely on a statistical basis, he proceeds as follows: At any particular time in the given locality, let the total value of the insured goods be G, and during T years determine from statistics

n_1 years during which the earthquake damage was less than $G/10$;
n_2 years during which the earthquake damage was between $G/10$ and $2G/10$;
n_3 years during which the earthquake damage was between $2G/10$ and $3G/10$.

. . . . . .

n_{10} years during which the earthquake damage was between $9G/10$ and G.

The probabilities that the occurrences may fall into the above categories may be estimated as

$$p_1 = n_1/T = \int_0^{G/10} y\,dx; \quad p_2 = n_2/T = \int_{G/10}^{2G/10} y\,dx$$

$$p_3 = n_3/T = \int_{2G/10}^{3G/10} y\,dx$$

. . . . . .

$$p_{10} = n_{10}/T = \int_{9G/10}^{G} y\,dx;$$

from which we obtain by approximation,

for $x = G/20$	$y = 10p_1/G$
for $x = 3G/20$	$y = 10p_2/G$
for $x = 5G/20$	$y = 10p_3/G$
. . .	. . .
for $x = 19G/20$	$y = 10p_{10}/G$

From these figures it is possible to construct a graph showing the form and variation of y with x. From the graph the premiums to be paid may be calculated after the values of A and U have been fixed by agreement. Thereafter adjustments would have to be made in the light of the considerations mentioned previously, it being assumed that the conditions will remain the same during the year.

In Switzerland, one of the foremost countries in dealing with insurance against all calamities caused by the forces of Nature, earthquake insurance is only undertaken by the Canton of Zurich, since the Swiss Re-insurance Union has advised against taking such risks on the grounds that it is impossible completely to predetermine the effects of an earthquake shock.

The "Fonds suisse" is, however, available in cases where insurance is impossible, and this now amounts approximately to two million francs. In New Zealand some earthquake insurance is undertaken by private companies, but the liability of these companies for payments under the Workers' Compensation for Accidents Act has been limited by the Government to £50,000 in a single earthquake or a series of earthquakes lasting seven days. In Great Britain certain companies undertake such insurance on request, but information is unavailable except from the companies concerned, there being apparently no clearing house for such information. In the United States, earthquake insurance is underwritten mostly by the mutual fire insurance companies, which state that the premiums need not be high if due attention is paid to earthquake-proof design in the buildings concerned.

CRYSTALLO-CHEMICAL ANALYSIS

THE BARKER INDEX AT OXFORD

BY DR. M. W. PORTER AND R. C. SPILLER, DEPARTMENT OF MINERALOGY, OXFORD

EVERY chemist is familiar with the well-developed crystals bounded by plane faces which are formed by chemical substances. That the angles between these faces are characteristic of the substance and can be measured accurately by the reflecting goniometer is also common knowledge.

Clearly it would be of advantage to the chemist were he able to make practical use of these characteristic angles for purposes of identification, as an alternative to the ordinary method of analysis. Only a very small amount of material would be required, for a crystal of the size of one cubic millimetre, or even less, can be accurately measured. Moreover, when the measurement is completed, the crystal remains intact. If an index were made which included all measured substances, arranged in the numerical order of their measured angles, any substance could be identified by measuring a crystal of it and seeking in the index the angular values obtained.

Why has the chemist hitherto been unable to make use of this method of identification?

The difficulty arises from the multiplicity of angles which can be measured on any given crystal and from the lack of guidance in the choice of the angles which are to be used as the basis of the index. It is clear that what is wanted is a set of rules which will ensure that two independent workers who have measured crystals of the same substance will choose, as characteristic of that substance, the same set of angles, by which it can be classified.

The number of chemical substances that have been measured considerably exceeds eight thousand, and the measurements of some seven thousand of these have been collected in the five large volumes of Groth's "Chemische Krystallographie", where they are arranged according to *chemical composition*. During the past thirty years, crystallographers have attempted to put this valuable material into such a form that it might be rapidly and successfully used in the identification of chemical substances. First among those to make such an attempt was Fedorov, the great Russian crystallographer. He devised a method of classification based on his theory of crystal structure and, with the help of his pupils, he produced his great index, "Das Krystallreich", which was published in 1920. It contained a list of all the crystals then measured, and by means of this index any of the substances could be identified by the measurement of its angles. The method employed in this remarkable work was, however, complicated, and the calculations required were lengthy and laborious.

The late Dr. T. V. Barker, of Oxford, who was Fedorov's pupil and enthusiastic collaborator, had hoped to make this method of practical use, but he gradually came to the conclusion that it was impossible to do so. After many years he devised a simpler method based, not as Fedorov's was, upon theories of crystal structure, but purely on geometrical form. His book "Systematic Crystallography" (Thomas Murby, London, 1930) describes a set of simple rules based on what he termed the "principle of simplest indices" (*op. cit.*, p. 2), which he proposed to make the foundation for a practical index of crystals. In this index, under each crystal system, a certain angle, chosen by these rules for each substance as the main classification angle, was to be incorporated in order of increasing magnitude. The rules ensured that no ambiguity could arise in the choice of the classification angles. Owing to pressure of other work, Dr. Barker published this short treatise "Systematic Crystallography" instead of a much larger and more ambitious work, the uncompleted manuscript of which is in the University Museum at Oxford. He hoped to begin work on the index in May 1931, but in April of the same year he was taken ill and died.

The possibility of compiling the Barker Index after the untimely death of its originator, and without his direction, was immediately discussed at Oxford by a number of crystallographers who were interested, and they decided to try out the method independently. At the end of a year, they unanimously concluded that the method was simple and workable. It was decided to proceed with the preparation of the Index and, with the kind permission of Prof. H. L. Bowman, to make its headquarters in the Mineralogical Department of the University Museum at Oxford.

In the initial stages of the work, certain unforeseen difficulties arose the solution of which involved time and labour. The first of these was that, in order to cover certain cases, it was found necessary to make minor modifications and additions in the rules drafted by Dr. Barker. The second difficulty was that considerable delay has been, and will continue to be, caused by the misprints and errors of computation found in the original descriptions. These have in all cases to be cleared up before the classification angles can be found. In order to guard against similar errors in the Barker Index itself, every calculation is being made independently by two workers and checked by a third before the results are typed on a card and filed in a card index.

When some years had been spent in the compilation of the Index, it was felt that it was sufficiently far advanced to offer material for a searching test of its usefulness in the actual identification of compounds. Such tests had been carried out successfully by Dr. Barker and were described in "Systematic Crystallography" (pp. 24–27), but his great familiarity with the work and the fact that the material available at that time was limited led us to believe that another trial of the method would be of practical value.

It was decided to carry this out in two of the less simple crystal systems, the orthorhombic and monoclinic, and a list of some 1,230 substances which were ready for the Index was sent to Prof. G. M. Bennett, professor of chemistry, King's College, London, who had kindly offered to collaborate in such a test. From this list Prof. Bennett selected sixteen substances which he sent, numbered, but unnamed, to us at Oxford. Fifteen of the sixteen were successfully identified. The measurement of the remaining one was not possible as the faces were not sufficiently good to give even fair reflections on the goniometer. The list of substances is given below, and it will be seen that many of them have a complicated chemical composition, and would be difficult to identify by other methods, especially if, as was the case, only one or two small crystals were available for examination. The time taken to identify each compound varied from thirty minutes for the easier crystals to four hours for the most difficult.

List of Compounds Identified by means of the Barker Index.

1. Ethyl-2 : 4-dinitrophenyl-aniline. (Groth, **5**, 53.)
2. Methylanilide of benzene sulphonic acid. (Groth, **5**, 78.)
3. Benzene-azo-β-naphthyl benzoate. (Groth, **5**, 390.)
4. Tribenzylamine. (Groth, **5**, 323.)
5. Phenyl benzoate. (Groth, **5**, 134.)
6. 1-Phenyl-3-methyl-4-benzylidene-pyrazolone. (Groth, **5**, 587.)
7. Methylanilide of p. toluene sulphonic acid. (Groth, **5**, 84.)
8. Sodium nitroprusside (dihydrate). (Groth, **1**, 432.)
9. Potassium sulphate. (Groth, **2**, 337.)
10. Sulphur. (Groth, **1**, 26.)
11. . . . . (unmeasurable).
12. Ammonium sulphate. (Groth, **2**, 344.)
13. Eugenol benzoate. (Groth, **5**, 139.)
14. Potassium nitrate. (Groth, **2**, 74.)
15. Potassium dihydrogen orthophosphate. (Groth, **2**, 795.)
16. Topaz. (Groth, **2**, 262.)

The procedure adopted in these identifications, which can only be outlined here, was as follows: The crystal (or in some cases two or three crystals) was measured on a two-circle reflecting goniometer. A gnomonic or stereographic projection was made from these measurements and the crystal system identified so far as possible from the projection and checked (if necessary) by the optics. The selection of the classification angles was made according to the Barker rules. The Index was then consulted under the appropriate crystal system for the main classification angle. Generally, a number of angles within the limits of the error of measurement offered themselves. The remaining classification angles were then compared and, when a set which agreed as a whole with those measured was found, the identification was established. When the classification angles indicated a member of an isomorphous group, a further test of a simple nature had to be made. It was recommended by Dr. Barker that such a test should be made in all cases as a check on the identification. The test may be a simple chemical one, the determination of the density, the observation of the colour or cleavage, or the examination of some of the optical properties.

No doubt the question will be asked, what happens if the classification angles are not to be found in the Index? This may happen owing to the fact that the faces of a crystal may vary in different circumstances of crystallization. New faces may appear and old faces may be suppressed. Certain new combinations of faces may give rise to classification angles not to be found in the Index. Actual cases of this sort occurred among the compounds given above and were successfully dealt with as follows: By the graphical insertion into the projection of one or two faces not observed, or the suppression of one or two of the faces present, a new set of classification angles was obtained. These were measured graphically in order to save time and then searched for in the Index, with successful results. Although the difficulty arising from the variability of faces, or of combinations of faces, has been brought forward as a disadvantage of the Barker method (see A. K. Boldyrew und W. W. Doliwo-Dobrowolsky, "Ueber die Bestimmungstabellen für Kristalle", *Z. Kristall.*, (A) **93**, 321–367; 1936) in actual practice it has not been found to be serious. Nor do the many hundreds of cases of different combinations of faces already recorded give rise to a great number of additional entries in the Index. In working through some 1,800 monoclinic and orthorhombic substances, we have found that about 2,300 entries are required. Donnay and Mélon (see Tables for Tetragonal Substances, Johns Hopkins University, Studies in Geology, No. 11, p. 328; Oct. 1934) in their tables for the tetragonal system found that 456 substances require 582 entries.

A further example of the value of the Barker method may be mentioned. With the help of it, F. A. Bannister and M. H. Hey were able to identify some crystals found in oceanic bottom samples from the Weddell Sea and brought back by the Scotia Expedition (Discovery Reports, **13**, 60–69, Cambridge, 1936). The crystals varied in size from 0·2 mm. × 0·1 mm. to 0·3 mm. × 0·15 mm., and several of these were successfully measured and the Barker classification angle determined. The tetragonal symmetry of the crystals was confirmed by their optics and by a Laue photograph. The authors identified the salt as hydrated calcium oxalate from a table of tetragonal substances compiled (independently of the tables by Donnay and Mélon) by Dr. Hey on Dr. Barker's method. Identification in the ordinary way, by means of chemical analysis, was in this case out of the question.

The above identifications give practical evidence of the usefulness of the Barker method, and encourage the belief that when once the Index is complete it will be of great service to chemist and crystallographer alike. Its compilation has now made considerable progress, but new collaborators would be welcomed as the work is necessarily slow. Practical help in the compilation of the Index has been given by Mrs. Barker, P. Terpstra, J. H. Haan, P. Stienstra, J. Mélon, J. D. H. Donnay, M. H. Hey, C. Judson and T. W. J. Taylor.

In conclusion, it may be pointed out that, in the descriptions of new substances to be made in the future, a minimum of calculation will be required if the Barker rules are applied, and the lengthy tables of angles frequently met with in crystallographic descriptions will be unnecessary.

CONTROL OF HEALTH SERVICES

A BROADSHEET "The Control of Health Services" issued by P E P (Political and Economic Planning) emphasizes the need for an administrative reorganization of the local public health services, and outlines various proposals which have been made with this object. From an administrative standpoint, public health services are divided into those directly administered by the central government departments, those controlled by local authorities under such supervision and the National Health Insurance Scheme. The central department primarily responsible for the public health services in England is the Ministry of Health, but the supervision of the school medical service is delegated to the Board of Education. The Board of Control, which is the supervising body of the services for mental patients and mental defectives, is responsible to Parliament through the Minister of Health, as is the General Register Office dealing with population statistics. Most of the Minister's powers over public health services in Wales are exercised through the Welsh Board of Health, while in Scotland the Department of Health for Scotland performs much the same functions as the Ministry of Health but controls the medical inspection of school children. The Medical Research Council is under a Committee of the Privy Council, while the Factory Act, including its medical provisions, is administered by the Home Office. The National Health Insurance Joint Committee co-ordinates the work of the Ministry of Health, the Department of Health for Scotland, the Welsh Board of Health and the Ministry of Labour for Northern Ireland in connexion with National Health Insurance.

Eighty-three county boroughs in England and Wales exercise all statutory health functions allocated to local government, but outside their territory these are distributed between 62 county councils, including the London County Council, 306 municipal boroughs, 575 urban districts, 476 rural districts, 28 metropolitan boroughs and the Corporation of the City of London. The 24 large Scottish burghs are virtually independent health authorities but except in Aberdeen, Dundee, Edinburgh and Glasgow are not concerned with the school medical services, while the 171 small burghs have fewer public health functions in their own right than the English district councils.

Administrative boundaries are already hindering developments which are possible through modern transport in centralization of equipment, and aerial defence is making regional planning of health services more urgent. The criticism in the report on the Anti-Tuberculosis Service in Wales and Monmouthshire could probably be applied to many areas in England. Financial stringency is not the only cause of failure to deal with overcrowding; failure of the counties to put pressure on inefficient district councils and to carry through a review of their areas, nepotism, prejudice, individualism and a refusal to spend money on communal services are contributory causes. The Committee on the Scottish Health Services in 1936 advocated that the Department of Health should be empowered to call on local authorities to submit schemes for the provision and maintenance of certain services for the areas of two or more authorities and similar proposals were made in the minority report of the Royal Commission on Local Government in the Tyneside Area in 1937 as an alternative to an even more radical proposal of the majority report for administration of specified health services by a regional authority.

Practically all these schemes, like that of the British Medical Association, "A General Medical Service for the Nation", propose an administrative division between the environmental and the personal health services, the former being administered by local units and the latter by regional authorities over a wide area. The British Medical Association scheme proposed that councils with a population of less than 75,000 in rural and 100,000 in urban areas should leave all their public health functions to a system of complete and comprehensive local public health administration units. The plans of the Ministry of Health to meet an emergency as revealed in the House of Commons may ultimately lead to radical changes in the organization of the health services.

MACROMOLECULES

IN a lecture to the Freiburger wissenschaftliche Gesellschaft (published by Hans Speyer Verlag Hans Ferdinand Schulz, Freiburg im Breisgau), Prof. H. Staudinger reviews the nature and importance of macromolecules, which play such an important part in the chemistry of living tissues. These compounds possess many unexpected properties which cannot be foreseen from a study of simpler substances.

A macromolecule is defined as one built up of not less than a thousand atoms bound together by primary valencies. At present no upper limit is known to the size of the molecule, but it is possible to group them into threads, plates and spheres. The simplest are high polymers derived from simple unsaturated compounds, for example, vinyl chloride polymerizes to a product in which three thousand simple molecules are combined by co-valencies and which is used for synthetic leather, tubing, etc. In this case the product is a complex mixture which can be partly resolved by fractionation into what are called *polymerhomologues*. Svedberg has shown that the molecules of many proteins are uniform but native cellulose can be partly depolymerized into lower products with varying degrees of polymerization. Thus a polymerhomologous series of celluloses exists and the same holds also for starch, glycogen, caoutchouc and balata.

A method has been found of studying changes in physical properties of the products and of their solutions with change in degree of polymerization. Both homopolar and heteropolar combinations are known. Hydrocarbons like polystyrols may form sols

with organic solvents but not with water, while the introduction of hydroxyl groups may reverse this effect. Again, the introduction of polar groups may result in hydrosol formation. By the polymerization of acrylic acid, it is possible to build up a complete polymerhomologous series with degrees of polymerization ranging from 10 to 2,000. These acids and their salts give osmotic pressures which are about one fifth of the theoretical values, and polyvalent anions may exert a similar buffering effect on the osmotic pressures of cations. The behaviour of albumens is particularly complicated, since both acid and basic radicals are present. The polyacrylic acids have served as a model in unravelling these complexities. The physical properties of linear or thread molecules depend on molecular length. It is convenient to group them into hemicolloids with length from 50 A. to 250 A., mesocolloids (250–2,500 A.) and eucolloids (above 2,500 A.) of which only the last-named group possesses typical macromolecular properties such as toughness, fibrous structure and the power of swelling. The viscosities of heteropolar thread molecules are complicated by swarming of the fibre-ions, which is affected by the presence of salts and acids.

Since macromolecules have the dimensions of colloid particles, any solutions that are formed are colloidal and may be termed macrocolloidal to distinguish them from the molecular colloids or micelles of soaps and dyes, which are very much less stable, since they do not involve principal valencies. In some cases macromolecules are formed by true condensation, for example, through loss of water. It is necessary to be able to distinguish between macromolecules and micelles. Particle size in homopolar compounds can be determined from osmotic pressure and with the help of the ultracentrifuge. The study of acetylated products is of great importance, for if the degree of polymerization is unaltered by acetylation the original compound must have been macromolecular since micelles could not withstand such drastic treatment. Unfortunately, this very simple principle is difficult in application since by-reactions may have a far-reaching effect.

Chemical investigation is rendered difficult by the fact that the greater the size of the macromolecule the smaller is the proportion of active reagent (water, oxygen, etc.) needed to bring about chemical change. Native caoutchouc contains thread molecules with a degree of polymerization of two to three thousand and swells greatly in water. On exposure to air the threads become linked at few points only by oxygen bridges so that an insoluble product results with limited swelling power, but the amount of oxygen absorbed is too small to determine. Nitrogen has no such action. Again, synthetic polystyrol threads can be linked at long intervals by using a minute amount of divinylbenzene so that a network is obtained which can be solvated but not dissolved. In some similar fashion, albumens can pass from a soluble form with unlimited swelling power to an insoluble form with limited swelling. Again, minute chemical changes such as methylation of terminal groups alone of a very long chain may influence chemical character; thus the dimethylether of polyoxymethylene is stable to sodium hydroxide. These facts are of great importance in the study of hormones and vitamins, which may be regarded not as mere catalysts but as reagents capable of reacting in minute quantities on macromolecules to produce far reaching effects.

SCIENCE NEWS A CENTURY AGO

The August Meteors seen at Breslau

On August 14, 1839, the German astronomer Boguslawski wrote an account of his observations at Breslau of the August meteors, popularly known as "the tears of St. Lawrence"; the account being published in the Prussian State Gazette. "The sky," he said, "has been again particularly propitious for observing another fall of stars. On many days and nights preceding the 10th the heavens have been so covered that we could not observe when the uncommonly frequent fall of stars commenced. On Aug. 10, however, our hopes of seeing the phenomena increased owing to the clearness of the weather. . . . It was not, however, sufficient to count the numbers that fell; it was desirable also to measure the time of their appearance, and of the continuance of their fall, according to Franzmann's instrument, which beats thirds of seconds, and moreover to ascertain their relative height and apparent course in the heavens and all these observations could commence only at 26 minutes past 9 when all the observers, 15 in number, were assembled, occupying six windows of the observatory. Four gentlemen took care to observe and register the times of each appearance, according to two clocks. Till 14 minutes past 3, when dawn put a stop to the observations, they noticed 1008 falling stars, not including numbers which must have been overlooked because the numbers of observers was insufficient". Other meteors were seen on August 11 and 12 and "therefore," wrote Boguslawski, "the annual periodical return of an uncommon fall of stars towards the 10th of August is once more confirmed".

Steam Applied to Land Drainage

On August 17, 1839, the *Mechanic and Chemist* said: "This drainage of land by steam power has been extensively adopted in the fens of Lincolnshire, Cambridgeshire, and Bedfordshire and with immense advantage. An engine of forty horse power, and scoop wheel for draining, and requisite buildings, costs about £4,000, and is capable of draining about 4,000 acres of land. In many places in the fens, land has been purchased at from £10 to £12 per acre, which has been so improved by drainage as to be worth £60 or £70 per acre". One of the largest districts drained was Deeping Fen near Spalding containing 25,000 acres, where there were pumping engines of 80 horse-power and 60 horse-power. Littleport Fen, near Ely of about 28,000 was drained by two engines whereas formerly there were 75 wind-driven pumps. Soham Mere, near Cambridge, forming a lake of 1,600 acres was drained by a 40 horse-power engine.

UNIVERSITY EVENTS

CAMBRIDGE.—J. C. Colbeck has been elected John Lucas Walker student.

A. F. Huxley, of Trinity College, has been elected to the Michael Foster studentship in physiology.

Dr. K. C. Dixon, of King's College, has been awarded the E. G. Fearnsides scholarship.

OXFORD.—Dr. L. A. Woodward, Lincoln College, has been appointed fellow and tutor of Jesus College in chemistry in succession to the late H. J. George.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

HEAD OF THE CHEMISTRY DEPARTMENT and a LECTURER IN ELECTRICAL ENGINEERING at the Burnley Municipal College—The Director of Education, Education Offices, Burnley (August 15).

GRADUATE LECTURER IN MECHANICAL ENGINEERING at the Coventry Technical College—The Director of Education, Council House, Coventry (August 16).

LABORATORY ASSISTANT (Male)—The Commandant, Experimental Station, Porton, near Salisbury (August 18).

HEAD OF THE DEPARTMENT OF ELECTRICAL ENGINEERING at the Liverpool Technical College—The Director of Education, 14 Sir Thomas Street, Liverpool 1 (August 23).

PROFESSOR OF VETERINARY SURGERY, OBSTETRICS AND ANIMAL HUSBANDRY at the Veterinary College, Ballsbridge, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (August 23)

PART-TIME DEMONSTRATOR IN BOTANY—The Secretary, Kings College, Strand, W.C.2 (August 26).

LECTURER IN CIVIL ENGINEERING at the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton (August 26).

UNIVERSITY LECTURER IN PHYSICS—The Secretary of the Appointments Committee of the Faculty of Physics and Chemistry, Cavendish Laboratory, Cambridge (August 31).

RESEARCH ASSISTANT in the Department of Coal Gas and Fuel Industries with Metallurgy—The Registrar, University, Leeds 2 (September 1).

INSTRUCTRESS IN RURAL DOMESTIC SCIENCE at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the County Council, County Hall, Chelmsford (September 1).

RESEARCH OFFICER in the Pathological Division of the Tea Research Institute of Ceylon—The Secretary, Ceylon Association in London, 11 Idol Lane, E.C.3 (September 9)

PROFESSOR OF ELECTRICAL ENGINEERING in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (September 15).

LECTURER in the Physiological Department—The Secretary, University, Birmingham 3 (September 16).

BACTERIOLOGIST—The Secretary, Royal College of Physicians, Edinburgh 2 (September 20).

TEMPORARY LECTURER IN EXPERIMENTAL ZOOLOGY—The Registrar, University, Liverpool (September 20).

PROFESSOR OF CHEMISTRY—The Registrar, Dacca University, P.O. Ramna, Dacca, Bengal, India (September 30).

OFFICIAL GUIDE-LECTURER—The Director, British Museum, W.C.1 (September 30).

UNIVERSITY ASSISTANT IN PHYSIOLOGY—The Secretary, University, Aberdeen (October 1).

ASSISTANT CIVIL ENGINEERS (temporary)—The Civil Engineer-in-Chief, Admiralty, Whitehall, S.W.1 (marked 'A. C. E. August').

TEACHER OF ELECTRICAL ENGINEERING—The Principal, Technical College, Wolverton, Bucks.

DIRECTOR OF RESEARCH—The Secretary, Gas Research Board, Gas Industry House, 1 Grosvenor Place, S.W.1.

RESEARCH SCHOLARSHIPS tenable in the Department of Coal Tar Colour Chemistry—The Principal, Technical College, Huddersfield.

ASSISTANT ENGINEER for the Sudan Government Railways—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (marked 'Engineer').

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

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Committee on Bird Sanctuaries in Royal Parks (England). Report for 1938. Pp. 38. (London: H.M. Stationery Office.) 9*d*. net. [277

A.R.P. in Industry: a revised and amplified Description of the Civil Defence Act, as it affects Owners and Occupiers of Industrial and Commercial Establishments. (Issued from the Lord Privy Seal's Office.) Pp. 16. (London: A.R.P. Department.) Free. [287

Forestry Commission. Nineteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1938. Pp. 61. (London: H.M. Stationery Office.) 1*s*. net. [287

City of Leicester Museum and Art Gallery. Thirty-fifth Report to the City Council, 1st April 1938 to 31st March 1939. Pp. 36. (Leicester: Museum and Art Gallery.) [287

Combustion Appliance Makers' Association (Solid Fuel). Proceedings of the Third Annual Conference, 1939, 28th and 30th March. (Document No. 3176.) Pp. x+402. (London: Combustion Appliance Makers' Association.) [317

Tuberculosis and Social Conditions in England: with Special Reference to Young Adults (a Statistical Study). By Dr. P. D'Arcy Hart and Dr. G. Payling Wright. Pp. vii+165. (London: National Association for the Prevention of Tuberculosis.) 3*s*. [317

Agricultural Research Council. A.R.C. Report Series, No. 5: Fodder Conservation, with Special Reference to Grass Drying. A Report prepared for the Committee on the Preservation of Grass and other Fodder Crops. By E. J. Roberts. Pp. v+137. (London: H.M. Stationery Office.) 2*s*. net. [317

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Two Bronze Age Cairns in South Wales: Simondston and Pond Cairns, Coity Higher Parish, Bridgend. By Sir Cyril Fox, with Appendices by L. F. Cowley, H. A. Hyde, Prof. John Percival and Dr. F. J. North. Pp. 125–180+plates 39–66. (Cardiff: National Museum of Wales.) 2*s*. 6*d*. [28

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd. Twenty-fourth Annual Report, 1938. Pp. 108. (Cheshunt: Nursery and Market Garden Industries' Development Society, Ltd.) [38

East African Agricultural Research Station, Amani. Annual Report, 1938. (Colonial No. 167.) Pp. 56. (London: H.M. Stationery Office.) 1*s*. net. [38

Other Countries

Meddelanden från Statens Skogsförsöksanstalt. Häfte 31, 1938–39. Pp. iv+401. (Experimentalfältet: Statens Skogsförsöksanstalt.) [287

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 21, No. 9 (Mathematics No. 37): Beiträge zur Geometrie der Kreise und Kugeln (30). Von Sôzi Matumura. Pp. 319–384. Vol. 26, No. 1 (Mathematics No. 38): Beiträge zur Geometrie der Kreise und Kugeln (31). Von Sôzi Matumura. Pp. 56. Vol. 26, No. 2 (Mathematics No. 39): Über Flächen und Kurven (21). Von Sôzi Matumura. Pp. 59–88. (Taihoku: Taihoku Imperial University.) [317

Transactions of the National Institute of Sciences of India. Vol. 3, No. 1: Amplification of the Theory of Multi-Phased Gastrulation among Insects, and its Applicability to some other Arthropods. By Dr. Mithan Lal Roonwall. Pp. 37. (Calcutta: National Institute of Sciences.) 4 rupees. [317

Report of the Kodaikanal Observatory for the Year 1938. Pp. 4. (Delhi: Manager of Publications.) 2 annas; 3*d*. [317

Cornell University: Agricultural Experiment Station. Bulletin 715: Economic Studies of Vegetable Farming in New York. 6: Production and Marketing of Celery, 1936. By J. N. Efferson. Pp. 62. Memoir 220: Joint Correlation applied to the Quality and Price of McIntosh Apples. By John R. Raeburn. Pp. 44. Memoir 221: Leguminous Plants and their Associated Organisms. By J. K. Wilson. Pp. 48+10 plates. Memoir 222: The Effect of Sulfur Fungicides on the Photosynthesis and Respiration of Apple Leaves. By R. A. Hyre. Pp. 40. Memoir 223: The Effect of Temperature and Relative Humidity on the Powdery Mildew of Roses. By Karla Langrée. Pp. 43. Memoir 224: Studies on Narcissus Mosaic. By Frank A. Haasis. Pp. 22+2 plates. (Ithaca, N.Y.: Cornell University Agricultural Experiment Station.) [317

Hand-Book of Common Water and Marsh Plants of India and Burma, 1936. By K. Biswas and C. C. Calder. (Health Bulletin No. 24: Malaria Bureau No. 11.) Pp. xiii+140+38 plates. (Delhi: Manager of Publications.) 2.12 rupees; 5*s*. [18

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Institut International d'Agriculture. Bibliothèque agricoles dans le monde et Bibliothèque specialisées dans les sujets se rapportant à l'agriculture. Pp. xxiv+311. (Roma: Institut International d'Agriculture.) 25 lire. [18

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Catalogues, etc.

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Catalogue of New Books on Chemistry, Pure and Applied. Pp. 50. (London: H. K. Lewis and Co., Ltd.)

Philips Technical Review. Vol. 4, No. 6, June. Pp. 153–180. (London and Eindhoven: Philips Lamps, Ltd.)

Die Askania-Warte. Nr. 18, Juli-August. Pp. 73–100. (Berlin-Friedenau: Askania-Werke A.G.)

The Clinical Application of Oestroform and Progestin B.D.H. in conditions associated with Menstruation and Pregnancy. Vol. 1, No. 4. Pp. 12. Thyrogan. Pp. 2. (London: British Drug Houses, Ltd.)

Dunns Seed Wheats, 1939. Pp. 32. (Salisbury: Dunns Farm Seeds, Ltd.)